3-D
RECLAIMED WATER TECHNOLOGY REVIEW AND EVALUATION OF POTENTIAL WATER REUSE OPPORTUNITIES

FINAL
ENVIRONMENTAL
IMPACT STATEMENT

Brightwater
Regional Wastewater
Treatment System

APPENDICES

King County Brightwater TREATMENT SYSTEM

Final

Appendix 3-D
Reclaimed Water Technology Review and Reuse Feasibility Analysis

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Prepared for King County by
CH2M HILL
Bellevue, WA

For more information:
Brightwater Project
201 South Jackson Street, Suite 503
Seattle, WA 98104-3855
206-684-6799 or toll free 1-888-707-8571

Alternative formats available upon request
by calling 206-684-1280 or 711 (TTY)

King County
Department of Natural Resources and Parks
Wastewater Treatment Division

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King County has prepared a Draft Environmental Impact Statement (Draft EIS) and Final Environmental Impact Statement (Final EIS) on the Brightwater Regional Wastewater Treatment System. The Final EIS is intended to provide decision-makers, regulatory agencies, and the public with information regarding the probable significant adverse impacts of the Brightwater proposal and identify alternatives and reasonable mitigation measures.

King County Executive Ron Sims has identified a preferred alternative, which is outlined in the Final EIS. This preferred alternative is for public information only, and is not intended in any way to prejudge the County's final decision, which will be made following the issuance of the Final EIS with accompanying technical appendices, comments on the Draft EIS and responses from King County, and additional supporting information. After issuance of the Final EIS, the King County Executive will select final locations for a treatment plant, marine outfall, and associated conveyances.

The County Executive authorized the preparation of a set of Technical Reports, in support of the Final EIS. These reports represent a substantial volume of additional investigation on the identified Brightwater alternatives, as appropriate, to identify probable significant adverse environmental impacts as required by the State Environmental Policy Act (SEPA). The collection of pertinent information and evaluation of impacts and mitigation measures on the Brightwater proposal is an ongoing process. The Final EIS incorporates this updated information and additional analysis of the probable significant adverse environmental impacts of the Brightwater alternatives, along with identification of reasonable mitigation measures. Additional evaluation will continue as part of meeting federal, state, and local permitting requirements.

Thus, the readers of this Technical Report should take into account the preliminary nature of the data contained herein, as well as the fact that new information relating to Brightwater may become available as the permit process gets underway. It is released at this time as part of King County's commitment to share information with the public as it is being developed.

EXECUTIVE SUMMARY

This technical memorandum evaluates the most likely and reasonable potential initial and future reuse opportunities for reclaimed wastewater from the Brightwater Regional Wastewater Treatment Plant. Reuse opportunities are grouped into potential reuse projects for evaluation and cost estimate development.

Potential reuse water users were identified in the Reclaimed Water Program Demonstration project conducted in Year 2000 for King County. At that time, there were a number of locations identified throughout the County that could potentially use Class A water. In assessing the potential demand for reclaimed wastewater, sites for the beneficial, direct, non-potable use of Class A reuse water were identified for irrigation (landscape, agricultural) and/or industrial use. Irrigation can include applications such as parks, commercial nurseries, golf courses, and cemeteries. Industrial uses of reuse water can include boiler feed, cooling, and process water.

The potential reuse water users in the Year 2000 study were refined and eventually narrowed down based on the two alternative Brightwater plant sites: Unocal and Route 9. Potential reuse water users within an approximate 5-mile radius of each of those sites and the Route 9 effluent tunnel were further studied by field reconnaissance and discussions with King County. Potential water reuse opportunities within the Brightwater facility were also identified and evaluated.

There were only a few potential industrial opportunities identified for either site based on zoning maps. Those areas were investigated to determine if the industries were considered "wet," or had a high demand for water. The results of the field reconnaissance identified predominantly "dry" industries, and no potential industrial uses for reuse water were identified.

This evaluation identified a total of 13 potential water reuse opportunities for the Unocal site. These included golf clubs, cemeteries, and other irrigation sites. The combination of all reuse opportunities in the Unocal site area shows a total potential peak day water demand of 8.4 mgd.

Reuse opportunities for the Route 9 site, the County Executive's preferred plant location, were grouped with respect to their location to the plant site (northeast, west, south, and within Brightwater facility opportunities). "Initial" opportunities are closer to the reuse water source (the Route 9 site or the effluent tunnel) and "future" opportunities are farther away from the reuse water source.

The Route 9 site initial seasonal peak day demand could reach 9.4 mgd, and the future seasonal peak day reuse water demand could reach 45.5 mgd, resulting in a total future demand (initial plus future demands) of 54.9 mgd. Because the Route 9 site is the preferred plant location, the focus of the technical memorandum is based on the Brightwater plant located at the Route 9 site.

The two treatment process options that have been proposed for the Brightwater plant are conventional activated sludge (CAS) and membrane bioreactor (MBR) treatment technology. At this time, MBR is the preferred treatment option and is therefore the focus of this technical memorandum. An MBR treatment plant would facilitate reuse water application since no additional tertiary treatment would be required to achieve Class A reuse water standards—only disinfection of the MBR effluent using ultra violet (UV) radiation would be required. A CAS plant effluent would require filtration in addition to UV disinfection of the CAS effluent in order to achieve Class A reuse water standards.

A general conveyance system framework was developed to convey reuse water from the preferred Route 9 site alternative to each of the water reuse opportunities. The conveyance system includes pump stations, conveyance pipe, and special crossings required for negotiating major roads and streams. The current Brightwater tunnel configuration includes an influent/effluent tunnel (combined tunnel) between the Route 9 site and proposed Portal 44, and an effluent tunnel from proposed Portal 44 to Puget Sound. Reuse water could be conveyed through the combined tunnel from the Route 9 site to proposed Portal 44 through the effluent pipes, or through a dedicated reuse pipe. If direct withdrawal of MBR effluent from the effluent pipes is accepted by the regulatory agencies, a dedicated reuse pipe from the Route 9 site to Portal 44 would not be required, which would result in a decreased water reuse delivery unit cost.

Direct withdrawal of MBR effluent from the effluent pipes at Portal 41 to serve potential Sammamish Valley (South) reuse water customers could prove to be a cost-effective means of reuse water delivery. A potential initial reuse water demand of 1.5 mgd and a potential total future reuse water demand of 10.0 mgd have been identified in the Sammamish Valley. Assuming direct withdrawal of MBR effluent from the effluent pipes at Portal 41 is acceptable, the initial Sammamish Valley project cost would be approximately $22.2 million and the future Sammamish Valley project cost would be approximately $34.1 million. However, at this time,

Sammamish Valley projects are not included as part of the first phase recommended water reuse program because of pending King County decisions on reuse water in the Sammamish Valley.

There are a multitude of combinations of reuse projects that could be constructed initially, depending on site availability, demand, and cost. The specific reuse projects and schedule for the initial phase of the Brightwater facility will be determined by King County in the next phase of design following discussions with candidate customers. The selection and implementation of projects will be based, in part, on utilizing the 5 mgd of reuse capacity that is currently planned with the initial onsite Brightwater facilities, preserving options for future opportunities, and minimizing both initial and long-term cost.

The projects described in the table below would generally result in compliance with these criteria if all projects were implemented in Phase 1. Implementation of specific projects will likely occur in phases depending on customer demand. The order in which the projects are presented in the table below represents a possible logical order of implementation.

Recommended Construction Projects[d]	Reclaimed Water Flow, mgd	Project Cost[a]	Levelized Unit Cost, $/CCF
Reuse Application at Brightwater site	1.5c	$2.6M	$1.27
Wellington Hills	0.7	$3.2M	$3.39
First Phase of West Initial Alternative 2 (direct tunnel withdrawal) b	1.4	$6.1M	$3.11
Northeast Initial (excluding Wellington Hills)	2.0	$15.1M	$5.47
Total	5.6 mgd[c]	$27.0M[e]	$3.49[e]

[a]Total project costs include 18% for contractor overhead and profit, 25% for contingency, 8.9% for sales tax, and 35% for allied costs.

[b]This project provides increment of reclaimed water to provide a total reuse water flow of at least 5.0 mgd.

[c]The in-plant reuse water consumption is assumed and could be higher. However, note that the presented order of project implementation would not change if the in-plant reuse water usage was greater than 1.5 mgd.

[d]The actual order of project implementation will depend largely on the identification of customers that would actually use reclaimed water. The presented order of implementation is based on the assumptions described in this section and will be modified when a water reuse customer identification program is implemented.

[e]Because each of these projects are stand-alone projects, the total of the project costs is likely high. If all of the projects were implemented, the total project cost would likely be approximately $4.25M lower because of economies of scale. The levelized unit cost would be approximately $3.25/CCF if all of the projects were implemented as part of Phase 1.

1.0 INTRODUCTION

King County Department of Natural Resources (KCDNR) is currently evaluating the reclaimed wastewater (reuse water) potential from a future regional wastewater treatment plant (Brightwater). This technical memorandum (TM) evaluates what is believed to be the most likely and reasonable potential initial and future reuse opportunities. In addition, this memorandum

presents potential reuse projects (groups of reuse opportunities) and a cost evaluation of each reuse project.

1.1 Technical Memorandum Background

During the development of this technical memorandum, a separate study (Brightwater – Sammamish Reuse TM) evaluated in detail the conveyance system that would be required to serve Sammamish Valley reuse customers from Brightwater. The Brightwater – Sammamish Reuse TM was prepared by Brown and Caldwell and is titled *Brightwater – Sammamish Project Conveyance (Based on York Alternative Site* and is included as Attachment D. Previous feasibility studies evaluated providing reuse water to Sammamish Valley customers through implementation of a Sammamish Valley satellite reclaimed water production facility. The purpose of the Brightwater – Sammamish Reuse TM was to compare the Brightwater reuse water conveyance system required to serve Sammamish Valley reuse customers to the Sammamish Valley satellite reclaimed water production facility project.

This technical memorandum originally developed conveyance systems to serve all identified reuse water opportunities, including Sammamish Valley reuse customers. However, the Brightwater – Sammamish Reuse TM developed more detailed conveyance system information for the Sammamish Valley reuse customers than the original technical memorandum, so this revision of the technical memorandum replaces previous Sammamish Valley reuse projects (South projects) with information developed as part of the Brightwater – Sammamish Reuse TM. The conveyance configuration Alternative 2 (Sammamish Bike Trail) from the Brightwater – Sammamish Reuse TM is the preferred South conveyance alternative at this time.

The figures presented in this technical memorandum illustrate potential Sammamish Valley (South) water reuse customers, but they are based on information developed as part of the original technical memorandum. Current details of the South reuse water projects are presented in the Brightwater – Sammamish Reuse TM in Attachment D.

1.2 Identified Reclaimed Water Projects

Potential reuse water users were identified in the Reclaimed Water Program Demonstration Phase – Identification of Potential Satellite Projects for Direct Non-Potable Uses, that was prepared for KCDNR in 2000. At that time, there were a number of locations identified throughout the County that could potentially use Class A reuse water. In 2001, KCDNR identified six potential plant sites during the Siting Study for the Brightwater plant. The potential reuse water users in the 2000 study were then refined, based on the specific potential Brightwater sites that were identified. Currently, the potential Brightwater sites have been narrowed down to two treatment plant site alternatives – Edmonds and Route 9. The identification of potential reuse water users within an approximate five-mile radius of each of those sites has been further refined with field reconnaissance and discussions with KCDNR. Potential reuse water users within 5 miles of the effluent tunnel for Route 9 were also identified. Figure 1 shows the current preferred route for the effluent tunnel, the location of both potential Brightwater sites and identified potential reuse opportunities.

2.0 POTENTIAL USES FOR RECLAIMED WATER

In assessing the potential demand for reclaimed wastewater, sites for the beneficial, direct, non-potable use of Class A reuse water were identified for irrigation (landscape, agricultural) and/or industrial use. Irrigation can include applications such as parks, commercial nurseries, golf courses, and cemeteries. Industrial uses of reuse water can include boiler feed, cooling, and process water.

2.1 Water Quality

The current goal for Brightwater is to treat all wastewater received to a secondary level. Tertiary treatment would be required to meet Class A reuse water quality requirements.
Class A reuse water would be used to irrigate landscaped areas with unrestricted access, such as parks, golf courses, agricultural areas, or cemeteries, as well as industrial uses. This use falls under the most stringent reuse criteria set by the Washington State Department of Health (DOH), which requires reuse water to be oxidized, coagulated, filtered, and disinfected.

2.2 Constraints and Requirements

This section describes the general requirements associated with constructing, operating, and permitting reuse water facilities proposed for the Brightwater project. The majority of the construction and operational requirements for the reuse water facilities are regulated by the State of Washington. The Washington State Departments of Health and Ecology have a number of requirements related to operating a reuse water facility and providing suitable environmental safeguards to protect the environment. The requirements are the same for both potential treatment plant sites since the projected uses of reuse water are the same, namely irrigation. These requirements are listed in the 1997 *Water Reclamation and Reuse Standards*.

To operate a reuse water facility and/or a water reuse application site for irrigation, a reuse water permit is required. Departments of Health and Ecology also require interagency agreements to be in place prior to delivery of reuse water.

Potential permits vary widely, depending on the project specific characteristics of the use site. A partial list of possible generic permit and procedural issues that may be needed for the reclamation projects are shown in Table 1.

TABLE 1
Possible Permit and Procedural Issues for Reuse Water Projects

Project Phase	Possible Permit and Procedural Issues
Planning	Additional SEPA Compliance (if necessary given consideration in EIS) Public Involvement Process Develop Purveyor Agreements Communications with Stakeholder Agencies DOH/Ecology Approval of Facilities Plan
Pre-Design	Public Involvement process Evaluate Real Estate and Right-of-Way Needs Project Specific SEPA Environmental Review (if necessary given consideration in EIS) Site Specific Permits as Needed (e.g. sensitive areas permits, local environmental permits, etc) Communications with Stakeholder Agencies
Design	Public Involvement Process Communications with Stakeholder Agencies DOH/Ecology Approval of Construction Documents Local Building Permits
Construction	Public Involvement Process Communication with Stakeholder Agencies DOH/Ecology Approval of Construction Assurance Plan One-year Certification

2.3 Water Reuse Opportunities

A field reconnaissance conducted in July 2002 consisted of driving by each of the potential irrigation and industrial sites in the study area that had been identified in the Demonstration Phase of the Brightwater project in 2000. When looking at irrigation sites, the reconnaissance team noted whether irrigation was currently taking place. If a site previously identified as a potential irrigation site was obviously not currently irrigated or in a 'natural' state, then it was removed from the list of potential sites. Many of the previously identified parks were eliminated for this reason.

There were only a few potential industrial sites that had been identified previously based on zoning maps. Those areas were investigated to determine if the industries were considered "wet," meaning having a high demand for water. The results of the field reconnaissance identified predominantly "dry" industries, and no potential industrial uses for reuse water were identified.

Table 2 presents a summary of reuse opportunities in the Edmonds project area and their acreages and estimated water demands. The combination of all sites requires a total potential peak day water demand of 8.4 mgd.

TABLE 2
Potential Water Reuse Opportunities – Edmonds

Water Reuse Opportunity	Estimated Acreage		Estimated Water Demand		
	Total1	Irrigable2	Average Seasonal (mgd)3	Seasonal Peak Day (mgd)4	Water Right, Application, or Claim, (mgd)
Jackson Park Golf Course	160	160	0.52	0.8	
Abbey View Cemetery	74	74	0.21	1.1	1.1
Ballinger Park Golf Course	48	48	0.26	0.4[6]	
Holyrood Cemetery	76	76	0.21	0.3	0.5
Nile Temple Golf Course	112	112	0.45	0.7	0.5
Seattle Golf and Country Club	138	138	1.14	1.8	1.3
Lynnwood Municipal Golf Course	36	36	0.39	0.6	0.4
Standard Oil of California				0.4[5]	0.4
Edmonds Memorial Cemetery				0.2[5]	0.2
Yost Memorial Park				0.3[6]	
Restlawn Memorial Gardens				0.3[5]	0.3
Edmonds Community College				0.2[6]	
Highlands Inc.				0.3[5]	0.3
Within Brightwater Facility				1.0[7]	
TOTAL				8.4	

[1] Estimated total acreage determined from available GIS mapping.
[2] Irrigable acreage based upon field estimate or following estimation: 25% total acreage = irrigable acreage in parks; 100% total acreage = irrigable acreage in golf courses, cemeteries and agricultural land based on previous studies for KCDNR.
[3] Estimated seasonal water demand (May through September) calculated by dividing the peaking factor of 1.54 from *KCDNR Identification of Potential Satellite Projects or Direct Non-Potable Uses – Summary Report,* December 2000.
[4] Peak-day demands (PDD) of non-agricultural uses provided by KCDNR.
[5] Based on Water Right, Application, or Claim data provided by KCDNR.
[6] Based on data provided by KCNDR.
[7] Assumed that up to 1.0 mgd of reclaimed water could be used at the Brighwater site for process water needs, irrigation and other uses.

Table 3 presents a summary of reuse opportunities in the Route 9 site area and their acreages and estimated water demands. This table identifies water reuse opportunities near the plant site and near the effluent tunnel. Reuse opportunities are grouped with respect to their location to the Route 9 site. Opportunity sites grouped as "Initial" opportunities are closer to the reuse water source (the Route 9 site or the effluent tunnel) and "Future" opportunities are farther away from the reuse water source.

For nearby opportunities northeast of the Route 9 site alternative, there is an estimated 2.7 mgd of potential water demand for peak day irrigation. The west opportunities near the preferred effluent tunnel route (i.e. within ½ mile of the effluent tunnel corridor) would add an additional potential seasonal peak day demand of 3.7 mgd. The outer "future" west opportunities (i.e. between ½ mile and 5 miles of the effluent tunnel corridor) would add an additional seasonal peak day demand of 3.7 mgd. The future opportunities to the south of Route 9 would add an additional seasonal peak day demand of 10.0 mgd. If large-scale agricultural opportunities are considered within and just outside (to the northeast) an approximate 5-mile radius of the Route 9 site, an additional peak day demand of 33.3 mgd could emerge in the future. Finally, it is assumed that up to 1.5 mgd could be used within the Brightwater facility for process water needs (1.0 mgd) , and irrigation (0.5 mgd). Based on all these potential opportunities, the seasonal peak day reuse water demand for the Route 9 site could reach 54.9 mgd.

Note that there are currently no water meter records for the potential agricultural sites shown on Figure 1. Few of the sites are currently irrigated and the extent of shift to irrigation if reuse water were available is not known. The evaluation of the direct non-potable options was based on the potential demand for reuse water but it does not reflect in-depth analysis or a survey of potential customers.

3.0 POTENTIAL WATER REUSE PROJECTS

This section presents water reuse projects, which are groups of water reuse opportunity sites previously described. The reuse projects were developed based on geographical location of the reuse opportunities and the probable order that reuse water would be provided to these sites. The water reuse projects described in the following sections of this memorandum are based on the Brightwater plant being located at the Route 9 site. The Wellington Hills reuse opportunity is included as a separate project to show it as a "stand-alone" project because of its proximity to the Route 9 site.

The names of the reuse projects describe the direction of the reuse sites relative to the Route 9 site alternative. The Northeast, South and West projects also include either "Initial" or "Future" in the reuse project name. An "Initial" project indicates that the water reuse opportunities within that project are generally geographically closer to the Route 9 site or the effluent tunnel system and would thus be implemented before projects with reuse sites that are farther away from the Route 9 site or effluent system, indicated as a "Future" project. Because of the strong likelihood that the "Initial" sites would be included if the "Future" sites were to be provided reuse water, the Northeast Future project includes the Northeast Initial project, the South Future project includes the South Initial project, and the West Future project includes the West Initial project. The reuse projects and their peak day demands are summarized in Table 4. Figure 2 shows the opportunity sites within each water reuse project and each site's peak day demand.

TABLE 3
Potential Water Reuse Opportunities – Route 9

	Water Reuse Opportunities	Estimated Acreage		Estimated Water Demand			
		Total[1]	Irrigable[2]	Average Seasonal (mgd)[3]	Seasonal Peak Day (mgd)[4]	Water Right, Application, or Claim, (mgd)	
Northeast Initial Opportunities							
	Wellington Hills Golf Course	80	80	0.45	0.7		
	Echo Falls Country Club	161	161	0.59	1.0[6]		
	Flower World Nursery	80	80	0.60	1.0[6]		
	Subtotal, Northeast Initial Opportunities				2.7		
West Initial Opportunities—Within 1/2-mile distance of Effluent Tunnel							
	Abbey View Cemetery	74	74	0.21	1.1[6]	1.1	
	Ballinger Park Golf Course	48	48	0.26	0.4[6]		
	Holyrood Cemetery	76	76	0.21	0.3	0.5	
	Nile Temple Golf Course	112	112	0.45	0.7	0.5	
	Standard Oil of California				0.4[5]	0.4	
	Edmonds Memorial Cem.				0.2[5]	0.2	
	Restlawn Memorial Gards.				0.3[5]	0.3	
	Highlands, Inc.				0.3[5]	0.3	
	Subtotal, West Initial Opportunities				3.7		
West Future Opportunities—Within 1/2-mile to 5-mile distance of Effluent Tunnel							
	Jackson Park Golf Course	160	160	0.52	0.8		
	Seattle Golf & Country Club	138	138	1.14	1.8	1.3	
	Lynnwood Municipal Golf	36	36	0.39	0.6	0.4	
	Yost Memorial Park				0.3[6]		
	Edmonds Community Coll.				0.2[6]		
	Subtotal, West Future Opportunities				3.7		

TABLE 3
Potential Water Reuse Opportunities – Route 9

	Water Reuse Opportunities	Estimated Acreage		Estimated Water Demand			
		Total[1]	Irrigable[2]	Average Seasonal (mgd)[3]	Seasonal Peak Day (mgd)[4]	Water Right, Application, or Claim, (mgd)	
South Initial Opportunities							
	Agricultural, Parks, Golf Course				1.5[6]		
South Future Opportunities							
	Agricultural, Parks, Golf Courses, Winery, Etc.				8.5[6]		
Northeast Future Opportunities							
	Agricultural site and Bob Heirman Wildlife Park	8,493	8,493	19.54	33.3[7]		
Within Brightwater Facility Opportunities							
	Process water, irrigation etc.				1.5[8]		
	GRAND TOTAL				54.9		

[1] Estimated total acreage determined from available GIS mapping.

[2] Irrigable acreage based upon field estimate or following estimation: 25% total acreage = irrigable acreage in parks; 100% total acreage = irrigable acreage in golf courses, cemeteries and agricultural land based on previous studies for KCDNR.

[3] Estimated seasonal water demand (May through September) calculated by dividing the peaking factor of 1.54 from *KCDNR Identification of Potential Satellite Projects for Direct Non-Potable Uses – Summary Report,* December 2000.

[4] Peak-day demands (PDD) of non-agricultural uses are listed in database provided by KCDNR.

[5] Based on Water Right, Application, or Claim data provided by KCDNR.

[6] Reference Brightwater – Sammamish Reuse TM in Attachment D. Total South Future Opportunities would be 10.0 mgd.

[7] Water demand for agricultural areas estimated based on water demand for alfalfa in the Seattle area, State of Washington Irrigation Guide, 1990.

[8] Assumed that up to 1.5 mgd of reclaimed water could be used within the Brightwater facility for process needs, irrigation and other uses.

TABLE 4
Water Reuse Project

Water Reuse Project	Water Reuse Opportunity	Peak Day Demand (mgd)
Wellington Hills	Wellington Hills	0.7
Northeast Initial	Wellington Hills	0.7
	Flower World	1.0
	Echo Falls Country Club	1.0
	Northeast Initial Total	2.7
Northeast Future	Northeast Initiala	2.7
	Agricultural & Bob Heirman Wildlife Park	33.3
	Northeast Future Total	36.0
West Initial	Highlands Inc.	0.3
	Abbey View Cemetery	1.1
	Holyrood Cemetery	0.3
	Nile Temple Golf Course	0.7
	Ballinger Park Golf Course	0.4
	Edmonds Memorial Cemetery	0.2
	Restlawn Memorial	0.3
	Standard Oil	0.4
	West Initial Total	3.7
West Future	West Initial[a]	3.7
	Jackson Park Golf Course	0.8
	Seattle Golf and Country Club	1.8
	Yost Memorial Park	0.3
	Edmonds Community College	0.2
	Lynnwood Municipal Golf Course	0.6
	West Future Total	7.4
South Initial[b]	Agricultural, Parks, and Golf Courses	1.5
South Future[b]	South Initial	1.5
	Agricultural, Parks, Golf Courses, Winery, Etc.	8.5
	South Future Total	10.0
Within Brightwater Facility		1.5

[a]The West Initial project is included as part of the West Future project, and the Northeast Initial project is included as part of the Northeast Future project.

[b]Reference Brightwater – Sammamish Reuse TM in Attachment D.

3.1 Reuse Water Conveyance System Development Criteria

A general conveyance system framework was developed to convey reuse water from the Route 9 site alternative to each of the water reuse opportunities. The conveyance system includes pump stations, conveyance pipe, and special crossings required for negotiating major roads and streams.

The current Brightwater tunnel configuration (Route 9, 195th Alternative C2 provided by the Brightwater Conveyance Team) includes an influent/effluent tunnel (combined tunnel) between the Route 9 site and proposed Portal 44, and an effluent tunnel from proposed Portal 44 to the Puget Sound. The combined tunnel could contain an influent pipe(s) and two effluent pipes (see Figure 3). Reuse water could be conveyed through the combined tunnel from the Route 9 site to proposed Portal 44 through the effluent pipes, or through a dedicated reuse pipe. One reason a dedicated reuse pipe would be installed would be if DOE prohibits reuse water withdrawal directly from the effluent pipe (see the Regulatory Review section).

The following three alternatives have been identified for conveying reuse water from Route 9 to the West and South projects. These alternatives are applicable only to the West and South projects.

- Alternative 1 – Dedicated Reuse Pipe: Install a dedicated water reuse pipe inside the combined tunnel from Route 9 to the proposed Portal 44. Extend the dedicated water reuse pipe inside the combined tunnel from Portal 44 to the surface and install a dedicated water reuse pipe using open-cut trenching to each west and south reuse opportunity. A reuse water pump station would be required at the Route 9 site and as required downstream to service the West and South projects. The detail shown in Figure 3 (provided by the Brightwater Conveyance Team) depicts how the reuse pipe could be installed inside the combined tunnel.

- Alternative 2 – Direct Tunnel Withdrawal: Reuse water would flow by gravity through an effluent pipe inside the combined tunnel from Route 9 to Portal 44, and through the effluent tunnel from Portal 44 to Portal 19. Reuse water would be pumped directly from the effluent pipe inside the combined tunnel at Portal 41 for the South projects, and directly from the effluent tunnel (downstream of Portal 44) at various withdrawal points for the West projects. Once pumped to the surface, reuse water would be conveyed through open-cut, surface routed conveyance pipe to each project.

- Alternative 3 – Dedicated Reuse Pipe (inside effluent tunnel): Install a dedicated water reuse pipe inside the combined tunnel from the Route 9 site to the proposed Portal 44 and extend the dedicated water reuse pipe inside the combined tunnel to the effluent tunnel from Portal 44 to Portal 19. The detail shown in Figure 4 (provided by the Brightwater Conveyance Team) depicts how the reuse pipe could be installed inside the effluent tunnel. A reuse water pump station would be required at the Route 9 site and as required downstream to service the West and South projects.

At this time, Alternative 3 has been discounted from further analysis for the following reasons.

- Alternative 3 would be more expensive than Alternative 2, because a dedicated reuse pipe inside the tunnel from Portal 44 to Portal 19 would be required. It is less expensive to practice direct tunnel withdrawal as described in Alternative 2.

- If direct tunnel withdrawal (Alternative 2) is accepted by regulatory agencies, installing the dedicated reuse pipe in the effluent tunnel (Alternative 3) would not be necessary.

- The dedicated reuse pipe from Portal 44 to Portal 19 would have to be installed during the effluent tunnel construction and thus require an early decision. At this time, it is not expected that a regulatory decision on direct tunnel withdrawal would be made prior to commencement of tunnel design.
- If direct tunnel withdrawal (Alternative 2) is unacceptable to regulatory agencies, Alternative 1 could be implemented, and reuse water service to West projects would be preserved. The cost of Alternative 1 is only slightly greater than Alternative 3. The project unit cost of reuse pipe (24-inch) installation in the tunnel west from Portal 44 is $305/ft (Alternative 3) compared to $475/ft (Alternative 1).
- Delaying the construction of an open cut reuse pipe (Alternative 1) west from Portal 44 by approximately 20 years would result in its unit cost being equal to in-tunnel (Alternative 3) construction as part of the initial expansion. Constructing an in-tunnel reuse pipe from Portal 44 (Alternative 3) would require a large initial investment that would likely not be used until well into the future.

Table 5 summarizes the conveyance and pump station framework for each water reuse project analyzed. Although it is recognized that the West and South projects could have common conveyance features, each water reuse project is developed to be a stand-alone, independent project for comparison purposes. There are a multitude of combinations of project features that could be constructed initially, determined by reuse site availability, demand, and cost. Actual recommended first phase construction will be a combination of components from different potential water reuse projects identified in this Technical Memorandum.

TABLE 5
Water Reuse Project Conveyance Framework

Water Reuse Project	Conveyance Pipe Installation and Alignment	Pump Station Locations
Wellington Hills	Surface alignment from Route 9 to Wellington Hills Golf Course.	At the Route 9 site.
Northeast Initial	Surface alignment from Route 9 to Northeast Initial reuse opportunities.	At the Route 9 site and as required downstream.
Northeast Future	Surface alignment from Route 9 to Northeast Future reuse opportunities.	At the Route 9 site and as required downstream.
West Initial Alternative 1 – Dedicated Reuse Pipe	Dedicated reuse pipe inside combined tunnel from Route 9 to Portal 44, and surface alignment piping from Portal 44 to West Initial reuse opportunities.	At the Route 9 site and as required downstream.
West Initial Alternative 2[1] – Direct Tunnel Withdrawal	Effluent pipes inside the combined tunnel to Portal 44 and inside the effluent tunnel from Portal 44 to withdrawal points downstream. Surface alignments from withdrawal points to West Initial reuse opportunities.	At withdrawal points along the effluent tunnel (at Portal 5 and Portal 19) and as required downstream of withdrawal pump stations.
West Future Alternative 1 – Dedicated Reuse Pipe	Dedicated reuse pipe inside combined tunnel from Route 9 to Portal 44, and surface alignment piping from Portal 44 to West Future reuse opportunities.	At the Route 9 site and as required downstream.
West Future Alternative 2[1] – Direct Tunnel Withdrawal	Effluent pipe inside the combined tunnel to Portal 44 and inside the effluent tunnel from Portal 44 to withdrawal points downstream. Surface alignments from withdrawal points to West Future reuse opportunities.	At withdrawal points along the effluent tunnel (at Portal 5 and Portal 19) and as required downstream of withdrawal pump stations.

TABLE 5
Water Reuse Project Conveyance Framework

Water Reuse Project	Conveyance Pipe Installation and Alignment	Pump Station Locations
South	Effluent pipe inside the combined tunnel to Portal 41. Surface alignment from Portal 41 to I-405 and from North Creek storage facility to South reuse customers. Microtunnel under I-405 to North Creek storage facility.	At North Creek storage facility. Pressure head available at Portal 41 would be used to convey reuse water from Portal 41 to the North Creek storage facility.

[1]Direct tunnel withdrawal would be managed to not occur during episodes of ballasted sedimentation discharge.

Table 6 presents the assumptions and criteria used in the development of each conveyance system component.

TABLE 6
Conveyance Development Criteria[a]

Conveyance System Component	Criteria Description
Pump Stations	Max total dynamic head (TDH): Approximately 300 feet Flow: Designed for peak day flow demands. Application Pressure: Designed to provide a minimum of 20 psi at the point of application (reuse site).
Conveyance Pipe	Peak Velocity: 4 to 5 feet per second (fps). Pipe diameters were selected based on typical ductile iron pipe diameters. Flow: Designed to convey peak day flow demands. Surface Alignments: Generally along public rights-of-way (ROW) or along alignments of existing sewers.
Special Crossings	Construction: Microtunnel Approximate Length: Freeways/Major Arterials: 400 feet Other Major Street: 300 feet Streams: 450 feet

[a]See Brightwater – Sammamish Reuse TM in Attachment D for conveyance development details for South project.

Geographical information system (GIS) coverage was used to develop the conveyance pipe alignments and to generate elevation profiles along each alignment. The profiles were used to determine the total dynamic head (TDH) required for each pump station. In some cases, more than one pump station would be required to achieve the necessary total system TDH. In most

cases, if two pump stations would be required, the pump stations were located and sized so that both pump stations would have approximately the same TDH requirement. For purposes of this planning level analysis, no attempt was made to determine points along the conveyance pipe where the pipe could transition to a gravity pipe or act as a siphon. Refinements to reduce the TDH required would be made during a detailed design.

Special crossing locations were determined based on GIS coverage for major streets, stream, and rivers. No field visit was performed to verify that each identified special crossing would actually warrant installing the pipe using microtunneling. The number of special crossings accounted for would likely be conservative since the pipe could be installed under bridge crossings, for example.

Using the methods and criteria described above, the water reuse conveyance system was developed with sufficient detail to prepare a planning level cost estimate. Figures 5 through 13 show the Northeast, South and West water reuse projects and summarize the details of its conveyance components, including pump station locations, flow, and TDH, conveyance pipe alignments and diameters, and special crossing locations. Figures 12 and 13 are from the Brightwater – Sammamish Reuse TM in Attachment D.

3.2 Water Reuse Treatment Requirements

The treatment required for reuse water depends on the treatment process selected for the Brightwater plant. The two treatment process options that have been proposed for the Brightwater plant are conventional activated sludge (CAS) and membrane bioreactor (MBR) treatment technology. Because MBR is the preferred treatment option, the focus of this TM will be based on Brightwater being an MBR plant. For comparative purposes, the section at the end of this memorandum briefly discusses water reuse system requirements for a CAS plant.

The proposed Brightwater treatment scheme would provide split flow treatment: primary and secondary treatment (MBR) for base flows, and ballasted sedimentation treatment for flows in excess of base flows (split flow). To achieve effluent discharge water quality, there would be disinfection downstream of the MBR treatment process. At this time, hypochlorite has been selected as the preferred option for on-site disinfection of flows destined for discharge into Puget Sound. In order to achieve Class A reuse water quality, disinfection would be required downstream of the MBR process. The effluent hypochlorite system would be operated to control fecal coliform levels to 200 organisms/mL. Disinfection would be required to provide reclaimed wastewater consistent with the Class A bacteriological quality criterion of 2.2 total coliform/mL. For purposes of this analysis, it is assumed that all final reuse water disinfection would use ultra-violet (UV) radiation.

Table 7 summarizes UV disinfection locations that would be required for each water reuse project.

TABLE 7
UV Disinfection Locations for Water Reuse Projects

Water Reuse Project	Brightwater Treatment	Location of UV Disinfection
Wellington Hills, Northeast, and West Initial/Future Alternative 1 (Dedicated Reuse Pipe)	MBR	UV disinfection would be required at the Route 9 site and disinfected reuse water would be conveyed through dedicated water reuse pipes.
South and West Initial/Future Alternative 2 (Direct Tunnel Withdrawal)	MBR	UV disinfection would be required locally at withdrawal points along the effluent tunnel. For South Projects, UV disinfection would likely be located at the North Creek Pump Station, downstream of the new reuse water pumps.

Figures 14 and 15 schematically illustrate the UV disinfection locations summarized in Table 7, pump station locations, and the reuse water flow path. The elements highlighted in yellow indicate equipment components included as part of the water reuse cost evaluation.

3.3 Regulatory Review

For the reuse projects illustrated in Figure 14, the water reuse withdrawal point at the Brightwater plant could be upstream of where the ballasted sedimentation treated flow (split flow) line would combine with secondary effluent. Therefore, the reuse water quality would be unaffected by storm events activating the ballasted sedimentation process. For the South and West Alternative 2 projects illustrated in Figure 15, reuse water would be withdrawn from water in the effluent pipe and effluent tunnel, which would be downstream of the ballasted sedimentation discharge point, and therefore subject to blended effluent (MBR and ballasted sedimentation effluent).

At this time, a concept of configuring one effluent pipe to only convey MBR effluent (except during major storm events) and configuring the other effluent pipe to only convey ballasted sedimentation effluent is being considered. In this scenario, the two flow streams would be blended at Portal 44. Based on this preliminary design concept, there is a very high probability that during summer months the South projects could withdraw pure MBR effluent from the MBR effluent only pipe at Portal 41 (upstream of Portal 44). In other words, there is a very low probability there would be a storm event during summer months such that ballasted sedimentation effluent would exceed the capacity of the ballasted sedimentation effluent pipe and overflow to the MBR effluent only pipe. This concept will be investigated further during detailed design.

Frequency and Volume of Split Flows. It is assumed that reuse water would only be required during the 5 month irrigation season between May and September. To determine the frequency and volume of split flows during these months, 51 years of flow data were analyzed. Based on this flow data, Figure 16 was developed and shows the storm return period and the corresponding split flow volume. As the figure shows, approximately once every 2 years, the ballasted sedimentation system would be activated during reuse water months. It is estimated that there is a 60 percent probability that the ballasted sedimentation process would be activated during the months of May through September inclusive.

In order for the South and West Alternative 2 projects to be viable, the regulatory requirements regarding the acceptable volume (if any) of ballasted sedimentation effluent that could be blended with MBR treated effluent, and the requirements for water quality monitoring in the effluent tunnel would need to be reviewed. In addition, regulatory requirements would have to be reviewed to determine water quality, disinfection, or flushing requirements for the effluent tunnel subsequent to conveying split flow. It is possible that some regulatory based protocols could be developed to allow reuse water to be extracted from the effluent tunnel surrounding episodes when split flow is blended with MBR effluent. In the event of a split flow event, all normal reuse water extractions taken directly from the effluent tunnel would cease immediately. Since it is expected that the effluent tunnel would behave hydraulically as a plug flow reactor, the travel of the "plume" of ballasted sedimentation effluent initially injected in the effluent tunnel would be easily characterized as a function of flow rate and velocities in the conveyance system. To be conservative, it is suggested that this hydraulic characterization of the effluent tunnel be empirically developed by the use of tracer studies at a range of flow rates. This methodology is well understood and widely utilized in the drinking water industry to characterize hydraulic behavior of critical unit processes including clearwells used for final drinking water disinfection. The EPA has developed standard protocols for determining hydraulic behavior of reactors by identifying the actual detention time that 90 percent of the water passing through a reactor is retained within the reactor. This detention time parameter is identified as T_{10}, whereas T represents the nominal detention time at a given flow rate. By definition, the ratio of T_{10}/T for a perfect plug flow reactor is 1.0. The EPA protocols for determining the T_{10} values are described in *Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources,* Appendix C, March 1991. Numerous tracer compounds could be used such as non-reactive fluoride salts or perhaps conductivity. Developing the T_{10} characteristics of the effluent tunnel will enable King County to predict (with a reasonable degree of precision) when water in the effluent tunnel is unsuitable for reuse water withdrawals, and when the split flow event has passed, enabling the resumption of reuse water delivery. In addition to switching reuse water withdrawals on and off in response to predictions of ballasted sedimentation effluent plume migrations through the effluent tunnel, it is also suggested that water quality monitoring be utilized as another tool to confirm the acceptability of resuming reuse water withdrawals after the end of the split flow event.

Figure 17 illustrates the approximate travel time from Route 9 to various points along the effluent system as a function of effluent flow rate assuming $T_{10}/T = 1.0$. This information provides guidance on how much time would be required to flush the effluent system after a ballasted sedimentation discharge event. For the Phase 1 project, split flows will occur above the proposed MBR system capacity or 38 mgd. Therefore the maximum travel time to the outermost Portal 19 would be approximately 16 hours.

Potential Options for Treating MBR-Ballasted Sedimentation Blended Effluent. If it is determined by regulatory agencies that the probability and volume of ballasted sedimentation effluent is unacceptable for reuse water quality, the South and West Alternative 2 (direct tunnel withdrawal) projects illustrated in Figure 15 would not be feasible unless a suitable treatment process could be implemented to subsequently treat the blended effluent to Class A reclaimed water standards. According to the regulations, a blended effluent may not meet Class A reclaimed water standards, even with subsequent filtration and additional disinfection. The blended effluent would most likely have to receive some form of biological treatment to oxidize the wastewater in

order to achieve Class A standards. There are not any identified economically feasible biological treatment systems available that would be capable of oxidizing a blended effluent of this type. The BOD concentration of the blended effluent would be very low and require that any subsequent biological treatment system be constantly fed with raw wastewater (or some other suitable substrate) to keep the biological oxidation system operating efficiently.

3.4 Basis of Cost Evaluation

Based on the conveyance system details and water reuse treatment requirements previously described, a cost estimate was developed that includes capital costs, operation and maintenance (O&M) costs, and life cycle costs. Assumptions used to develop the cost estimate are summarized in Table 8. As previously mentioned, the South Projects were developed based on the assumptions and criteria described in the TM in Attachment D.

TABLE 8
Cost Estimating Parameters[a]

Parameter	Assumption	Comment
Contingency	25%	Applied to construction cost
Sales Tax	8.9%	Applied to construction cost and contingency
Allied Costs	35%	Applied to construction cost, contingency, and sales tax
Contractor Overhead & Profit	18%	Applied to base construction cost to yield construction cost.
Tabula Contractor Overhead & Profit	18%	King County's cost estimating software (Tabula) includes contractor overhead and profit in the planning level construction costs. The cost estimates are based upon previous King County project bid tabs. In order to be consistent with application of the contractor overhead and profit to all cost components as described on the line above, contractor overhead and profit was removed from the Tabula estimates.
Interest Rate for Debt Service	6.25%	
Discount Rate	3.0%	Consistent with other Brightwater related cost estimates.
Salvage Value	None	Typically, mechanical systems have no salvage value at the end of their design life. This is a conservative assumption since pipelines and structures typically will last 40 years or longer.
Design Life	20 years (mechanical systems)	
Power Cost	$0.05/kw-hr	
Pump Efficiency	75%	
Average Day to Peak Day Peaking Factor (PF) for May through September	1.54	Per KCDNR Identification of Potential Satellite Projects or Direct Non-Potable Uses – Summary Report, December 2000

TABLE 8
Cost Estimating Parameters[a]

Parameter	Assumption	Comment
Full Time Equivalent (FTE) Hours per year	1,850	
Labor Cost	$43	
Water Reuse Application Months	5 months	Assumed May through September
On-site vs. Remote System Costs	Equivalent	Although systems installed at the Route 9 site could be less, it was assumed on-site and remote system costs would be equal for this planning level analysis.
[a]Not applicable to the South Projects. See Brightwater – Sammamish Reuse TM in Attachment D for South Projects cost estimating details.		

Cost estimates were developed for the infrastructure required to provide reuse water and include buildings, pump stations, and UV disinfection. No cost estimates are provided for land acquisition.

Buildings. It was assumed that all pump stations and UV disinfection systems would be installed within buildings. Table 9 summarizes approximate building areas that would be required for various flow scenarios. Attachment A includes sketches for a typical building layout for a pump station, and for a typical building layout for a pump station and UV disinfection system.

TABLE 9
Building Area Requirements[a]

Components within Building	Building Area
Pump Station Only	
< 10 mgd	32’ x 42’ = 1,400 ft^2
36 mgd	32’ x 60’ = 2,000 ft^2
Pump Station and UV Disinfection	
< 10 mgd	PS: 32’ x 42’ = 1,400 ft^2 UV: 28’ x 60’ = 1,700 ft^2 Total Area = 3,100 ft^2
36 mgd	PS: 32’ x 60’ = 2,000 ft^2 UV: 40’ x 60’ = 2,400 ft^2 Total Area = 4,400 ft^2
[a]Not applicable to the South Projects. See Brightwater – Sammamish Reuse TM in Attachment D for South Projects cost estimating details.	

The construction cost of $165/ft^2 assumed for the buildings includes power, lighting, HVAC, and brick veneer architectural treatment. It is assumed that a generator would not be required within the building. The cost components described below include all other costs required for complete system installation. Total project costs are summarized at the end of this section.

Pump Stations. King County's cost estimating software, Tabula (version 1.0), was used to develop pump station cost estimates. Although Tabula was developed for wastewater pump station applications, it was determined that a reduction factor of 10 percent applied to the construction cost would yield typical water pump station costs. Water pumps are typically less expensive than wastewater pumps, and electrical classifications for water pump stations are not as extensive as for wastewater pump stations. Furthermore, an additional 10 percent reduction factor was applied to the construction cost to account for building costs, which are accounted for separately in this analysis. It was assumed that no pump redundancy would be required for reuse water applications.

The following assumptions were made within Tabula.

- Excavation Depth: 0 feet
- High Head TDH: 350 feet
- Low Head TDH: 250 feet

Attachment A includes a sketch of the pump suction connection to the effluent tunnel for the West Alternative 2 projects. A contingency of 5 percent was added to the construction cost for direct tunnel withdrawal pump stations along the effluent tunnel to account for coordinating with other facilities that could also use the portal (dechlorination, energy recovery, etc.).

It was assumed that approximately 0.1 full time equivalents (FTEs) would be required per mgd for pump station O&M. In addition, it was assumed that annual O&M for a pump station would be approximately 0.5 percent of the construction cost.

Table 10 summarizes the construction unit costs for high and low head pump stations.

TABLE 10
Pump Station Unit Cost[b]

	Construction Cost[a]	
Flow (mgd)	**Low Head (< 300 ft)**	**High Head (> 300 ft)**
0.5	$440,000	$610,000
0.9	$580,000	$810,000
1.4	$750,000	$1,060,000
2.0	$970,000	$1,360,000
2.7	$1,210,000	$1,710,000
3.7	$1,570,000	$2,210,000
5.1	$1,630,000	$2,340,000
7.4	$1,970,000	$2,850,000

TABLE 10
Pump Station Unit Cost[b]

	Construction Cost[a]	
Flow (mgd)	**Low Head (< 300 ft)**	**High Head (> 300 ft)**
10.0	$2,240,000	$3,320,000
36.0	$4,270,000	$6,440,000

[a]Construction cost is 80% of Tabula's cost estimate. Installed construction costs exclude contractor overhead and profit and other markups.

[b]Not applicable to the South Projects. See Brightwater – Sammamish Reuse TM in Attachment D for South Projects cost estimating details.

Conveyance Pipe. The cost estimate for conveyance pipe was developed using Tabula. Although Tabula was developed for wastewater applications, the cost for installing water pipe is typically similar. To verify the cost similarity, an additional cost estimate was prepared. The developed construction costs for water pipe are approximately 10 percent lower than construction costs generated by Tabula. Nevertheless, for planning purposes and to remain consistent with King County cost estimating procedures, Tabula was used for this water pipe cost estimate.

The following assumptions were made within Tabula.

- Depth of Cover: 6 feet
- Conduit Type: Force Main
- Trench Backfill Type: Imported
- Existing Utility Complexity: Average
- Dewatering: Minimal
- Pavement Restoration: Trench Width
- Traffic: Light

The Brightwater Conveyance Team developed the design approach and URS Consultants developed the cost estimate for the section of reuse pipe installed inside the combined tunnel (see Figure 3).

Table 11 summarizes the construction unit cost for different installation methods. It was assumed that water pipe O&M would be approximately 0.5 percent of the construction cost.

TABLE 11
Conveyance Pipe Unit Cost[c]

Diameter, inches	Open Cut Water Main Cost/ft[a]	Reuse Pipe Inside Combined Tunnel Cost/ft[a,b]
8	$131	---
10	$139	---
12	$149	---
14	$170	---
16	$181	$57
20	$210	---
24	$236	$85
30	$292	$106
36	$356	$127
48	$508	---

[a]Construction costs are installed construction costs, excluding contractor overhead and profit and other markups.

[b]Reuse pipe installed inside combined tunnel costs developed by the URS Consultants and modified to exclude contractor overhead and profit (18%).

[c]Not applicable to the South Projects. See Brightwater – Sammamish Reuse TM in Attachment D for South Projects cost estimating details.

Special Crossings. The cost estimate for installation of special crossings was also developed using Tabula. The following assumptions were made within Tabula for installation of pipe using microtunneling.

- Dewatering: Minimal
- Existing Utilities Complexity: Average
- Shaft Excavation Depths: 15 feet
- Surface Restoration: Hydroseed
- Easements: None
- Traffic: Light
- Intermediate Shafts: None

Table 12 summarizes the construction unit cost for a range of pipe diameters.

TABLE 12
Microtunnel Unit Cost[b]

Diameter, inches	Construction Cost/ft[a]
12	$572
15	$640
30	$1,021
48	$1,441

[a]Tabula construction costs are installed construction costs, excluding contractor overhead and profit and other markups.

[b]Not applicable to the South Projects. See Brightwater – Sammamish Reuse TM in Attachment D for South Projects cost estimating details.

UV Disinfection. The cost estimate for the UV disinfection system was developed based on UV system manufacturer's cost estimates. It was assumed that UV systems treating flows less than 8 mgd would use low pressure, high intensity systems and systems treating flows greater than 8 mgd would be treated using medium pressure, high intensity systems. Flow to all UV systems was assumed to have a transmittance value of 65 percent. It is assumed that all UV systems would be designed to achieve the 2.2 total coliform limit and sized per National Water Research Institute (NWRI) guidelines. These guidelines require that UV dosages for reuse water be three times the dosages that would be required for secondary effluent.

Table 13 summarizes the construction unit cost and UV system type for various flow ranges.

TABLE 13
UV Disinfection System Unit Cost and Type[b]

Flow, mgd	Construction Cost/mgd[a]	UV System Type
< 8	$0.11M	Low pressure, high intensity
8 to 10	$0.13M	Medium pressure, high intensity
36	$0.09M	Medium pressure, high intensity

[a]Construction cost includes installed mechanical and piping systems, channels, and electrical and instrumentation (20 percent of mechanical costs). Cost excludes contractor overhead and profit and other markups.

[b]Not applicable to the South Projects. See Brightwater – Sammamish Reuse TM in Attachment D for South Projects cost estimating details.

3.5 Cost Evaluation Summary

This section summarizes capital costs, annual O&M costs, total annualized costs, and levelized unit costs that were prepared for each water reuse alternative. Table 14 presents a capital and O&M cost summary. Figures 18 and 19 present total project capital and annual O&M costs, respectively.

A levelized unit cost was obtained from the ratio of the total annual costs (annual service debt and O&M costs) over the life cycle divided by the total volume of reuse water produced. The water volume was calculated based on the average water demand over the months of May through September. Table 15 summarizes the annual water volume calculated for each water reuse project.

Figure 20 presents the total annualized cost for each water reuse project, and Figure 21 presents the levelized unit cost for providing reuse water in dollars per hundred cubic feet ($/CCF).

4.0 RECOMMENDED WATER REUSE PHASE 1 PROGRAM FOR FIRST 5-MGD INCREMENT

This section summarizes the recommended water reuse program for Phase 1 of the Brightwater facility. There are a multitude of combinations of reuse projects that could be constructed initially, determined by reuse site availability, demand, and cost. The specific reuse projects and schedule for Phase 1 of the Brightwater facility will be determined by King County in the next phase of predesign efforts, which will include discussions with candidate customers. The following recommendations are intended as a place to begin that process and are based on meeting the following criteria:

- Provide up to approximately 5 mgd of reclaimed water service
- Preserve options to maximize future reclaimed water opportunities
- Minimize initial cost
- Minimize long-term cost

The individual projects described below would generally result in compliance with these criteria if all projects were implemented in Phase 1. Implementation of specific projects will likely occur in phases depending on customer demand. The order in which the projects are presented below represents a possible logical order of implementation.

4.1 Reuse Water Application at Brightwater

It is assumed that up to 1.5 mgd of reuse water could be used within the Brightwater facilities for process needs and irrigation. However, reuse water consumption within the Brightwater facility would likely be greater than 1.5 mgd during the first couple of years to establish landscape plant growth during the first couple of years after planting.

Table 14: Total Project Capital and Operation and Maintenance Cost

	Year 2003 Total Project Capital Cost, Millions of Dollars[a, b]					Year 2003 Annual O&M Cost, Millions of Dollars[a,c]				Total Annualized Cost, Millions of Dollars
Water Reuse Project	**B**	**PS**	**C**	**UV**	**Total**	**PS[d]**	**C[e]**	**UV[f]**	**Total**	
Within Brightwater Facility	$1.03	$1.22	$0.20	$0.22	$2.67	$0.01	$0.001	$0.003	$0.01	$0.25
Wellington Hills	$1.03	$1.02	$0.99	$0.15	$3.19	$0.02	$0.01	$0.002	$0.03	$0.31
Northeast Initial	$1.50	$4.38	$10.05	$0.59	$16.53	$0.07	$0.03	$0.01	$0.11	$1.58
Northeast Future	$1.50	$13.00	$64.09	$7.93	$86.52	$0.48	$0.18	$0.10	$0.76	$8.46
South Initial[g]	---	$0.788	$19.96[h]	$1.46	$22.21[h]	$0.03	$0.033	$0.005	$0.07	$2.04[h]
South Future[g]	---	$2.62	$26.8	$4.72	$34.14	$0.11	$0.133	$0.044	$0.28	$3.32
West Initial Alternative 1 –Dedicated Reuse Pipe	$1.50	$8.91	$24.89	$0.82	$36.11	$0.13	$0.07	$0.01	$0.21	$3.42
West Initial Alternative 2 –Direct Tunnel Withdrawal	$3.00	$7.33	$9.02	$0.82	$20.16	$0.09	$0.03	$0.01	$0.13	$1.92
West Future Alternative 1 – Dedicated Reuse Pipe	$1.96	$11.49	$44.21	$1.63	$59.30	$0.20	$0.13	$0.02	$0.35	$5.63
West Future Alternative 2 – Direct Tunnel Withdrawal	$3.00	$9.71	$24.76	$1.63	$39.09	$0.18	$0.07	$0.02	$0.28	$3.75

[a]B = buildings, PS = pump stations, C = conveyance (open cut water pipe, combined tunnel reuse water pipe, and special crossings), and UV = UV disinfection
[b]Total project costs include 18% for contractor overhead and profit, 25% for contingency, 8.9% for sales tax, and 35% for allied costs.
[c]Assumes water reuse application between months of May and September.
[d]Includes 0.5% of construction costs for annual O&M. Assumes $0.05/kw-hr and pump efficiency of 75%.
[e]Includes 0.5% of construction costs for annual O&M.
[f]Assumes $0.05/kw-hr.
[g]Reference Brightwater – Sammamish TM in Attachment D for cost estimating approach and assumptions.
[h]The South Initial conveyance cost was increased from $10.74 M (as presented in the Brightwater – Sammamish Reuse TM in Attachment D) to $19.96 M to account for increasing the water transmission main between Portal 41 and 124th from a 12-inch to a 30-inch to accommodate future flows.

TABLE 15
Reuse Water Volume

Water Reuse Project	Annual Water Volume, CCF (100 ft^3)[a]
Wellington Hills	93,000
Northeast Initial	356,000
Northeast Future	4,753,000
South Initialb	124,000
South Futureb	1,061,000
West Initial	488,000
West Future	977,000

[a]Assumes 5 months of water reuse application per year. Based on average day demands using a factor of 1.54 to go from average day to peak day.

[b]Reference Brightwater – Sammamish TM in Attachment D.

4.2 Wellington Hills Golf Course

Based on discussions with King County staff, there is a reasonable probability that the Wellington Hills Golf Course would be receptive to using reuse water. The Wellington Hills Golf Course is located less than a half a mile to the south of the Brightwater facility and would use approximately 0.7 mgd of reuse water. The proximity of this water reuse opportunity to the Brightwater facility makes it a feasible, low capital cost option.

4.3 First Phase of West Initial Alternative 2

A dedicated reuse pipe within the effluent tunnel between the Brightwater facility and proposed Portal 44 could be an unnecessary investment if direct tunnel withdrawals are allowed by DOE. Therefore, West Initial Alternative 2 (direct tunnel withdrawal) will be considered as a relatively low cost reuse project. The West Initial Alternative 2 project would allow reuse opportunities to the west of the Brightwater site to be incrementally implemented without large initial investment as reuse water needs arise. Only a portion of the West Initial Alternative 2 project would be required to achieve approximately 5 mgd of reuse water in combination with the other projects discussed. Therefore, to reduce conveyance costs, only those water reuse opportunities that are closest to a proposed effluent tunnel portal are considered. Water reuse opportunity sites including Holyrood Cemetery, Nile Temple Golf Course, and Ballinger Park Golf Course are less than a mile from proposed Portal 5 and would use approximately 1.4 mgd of reclaimed water.

4.4 Northeast Initial Project

It is recommended that the remainder of the Northeast Initial project (Flower World Nursery and Echo Falls Country Club) be installed during the first construction phase of the Brightwater project. These sites would use 2 mgd of reuse water. The Northeast Initial project sites are the closest to the Route 9 site and at this time, appear to be viable water reuse sites. Based on

discussions with King County staff, there is a reasonable probability that these project sites would be receptive to using reclaimed water.

It is not recommended that the conveyance system capacity for this project be increased to accommodate potential Northeast Future opportunities at this time. An additional easement could be obtained along the Northeast trunk to preserve the option for installation of a second barrel should the demand for reuse water at the Agriculture and Bob Heirman Wildlife Park arise.

4.5 South Projects

At this time, South projects are not included as part of the first phase recommended water reuse program because of pending King County decisions on reuse water in the Sammamish Valley. The South projects are feasible and as shown on Figure 21, could be comparable to other potential reuse water projects.

Table 16 summarizes the project costs for this recommended first phase water reuse construction program.

TABLE 16
Recommended Order of Implementation for First 5-mgd Reuse Water Increment

Recommended Construction Projects[d]	Reclaimed Water Flow, mgd	Project Cost[a]	Levelized Unit Cost, $/CCF
Reuse Application at Brightwater site	1.5c	$2.6M	$1.27
Wellington Hills	0.7	$3.2M	$3.39
First Phase of West Initial Alternative 2 (direct tunnel withdrawal) b	1.4	$6.1M	$3.11
Northeast Initial (excluding Wellington Hills)	2.0	$15.1M	$5.47
Total	5.6 mgd[c]	$27.0M[e]	$3.49[e]

[a]Total project costs include 18% for contractor overhead and profit, 25% for contingency, 8.9% for sales tax, and 35% for allied costs.

[b]This project provides increment of reclaimed water to provide a total reuse water flow of at least 5.0 mgd.

[c]The in-plant reuse water consumption is assumed and could be higher. However, note that the presented order of project implementation would not change if the in-plant reuse water usage was greater than 1.5 mgd.

[d]The actual order of project implementation will depend largely on the identification of customers that would actually use reclaimed water. The presented order of implementation is based on the assumptions described in this section and will be modified when a water reuse customer identification program is implemented.

[e]Because each of these projects are stand-alone projects, the total of the project costs is likely high. If all of the projects were implemented, the total project cost would likely be approximately $4.25M lower because of economies of scale. The levelized unit cost would be approximately $3.25/CCF if all of the projects were implemented as part of Phase 1.

5.0 WATER REUSE SYSTEM REQUIRED FOR A CONVENTIONAL ACTIVATED SLUDGE PLANT

As previously mentioned, the MBR treatment process is the preferred treatment process for the Brightwater plant. However, for comparison purposes, a brief discussion of water reuse system requirements for a CAS plant is included as part of this memorandum.

Water reuse information for the CAS plant is included solely for general background information on the types of facilities needed for reuse water production assuming CAS treatment at the Brightwater plant. Since MBR treatment has been selected as the preferred treatment process, this information may not be current or valid.

The water reuse projects and conveyance system previously described would be the same for a CAS plant. However, the reuse treatment requirements would be different. A CAS plant effluent would require both filtration and additional disinfection of the CAS effluent to achieve Class A reuse water. With respect to water reuse, the only difference between a CAS plant and an MBR plant is the requirement for filtration prior to disinfection. For purposes of this analysis, it is assumed that membrane filtration (MF) would be used to provide Class A reuse water when CAS is the base treatment process at Brightwater.

The cost estimate for the reuse water membrane filters was developed based on membrane filter manufacturer cost estimates. It was assumed that pressure membrane filters would be used to treat reuse water. Membrane filter manufacturers suggest that at higher flows (greater than 10 mgd), there could be cost savings if a submerged/vacuum filter is used. However, because pressure filters are typically used for reuse water applications and the majority of the flows would be less than 10 mgd, all membrane filters were assumed to be pressure filters.

Although typical membrane filter service life is 5 years, it was assumed to be 10 years since the operation would only be 5 months each year. It was assumed that approximately 0.05 FTE's would be required per 1 mgd for membrane filter O&M. Table 17 summarizes the construction unit cost for a range of flows.

Attachment C presents the following reuse water summary information based on Brightwater being a CAS plant:

- Schematics illustrating water reuse components required for each project.
- Total project capital, annual O&M, annualized, and levelized cost summary tables and figures.

TABLE 17
Membrane Filter Unit Cost

Flow, mgd	Construction Cost/mgd[a]
1 to 2	$1.12M
2 to 4	$0.98M
4 to 5	$0.84M
5 to 10	$0.77M
11 to 20	$0.70M
21 to 30	$0.63M
>30	$0.58M

[a]Construction cost includes installed mechanical and piping systems, and electrical and instrumentation (20 percent of mechanical costs). Cost excludes contractor overhead and profit and other markups.

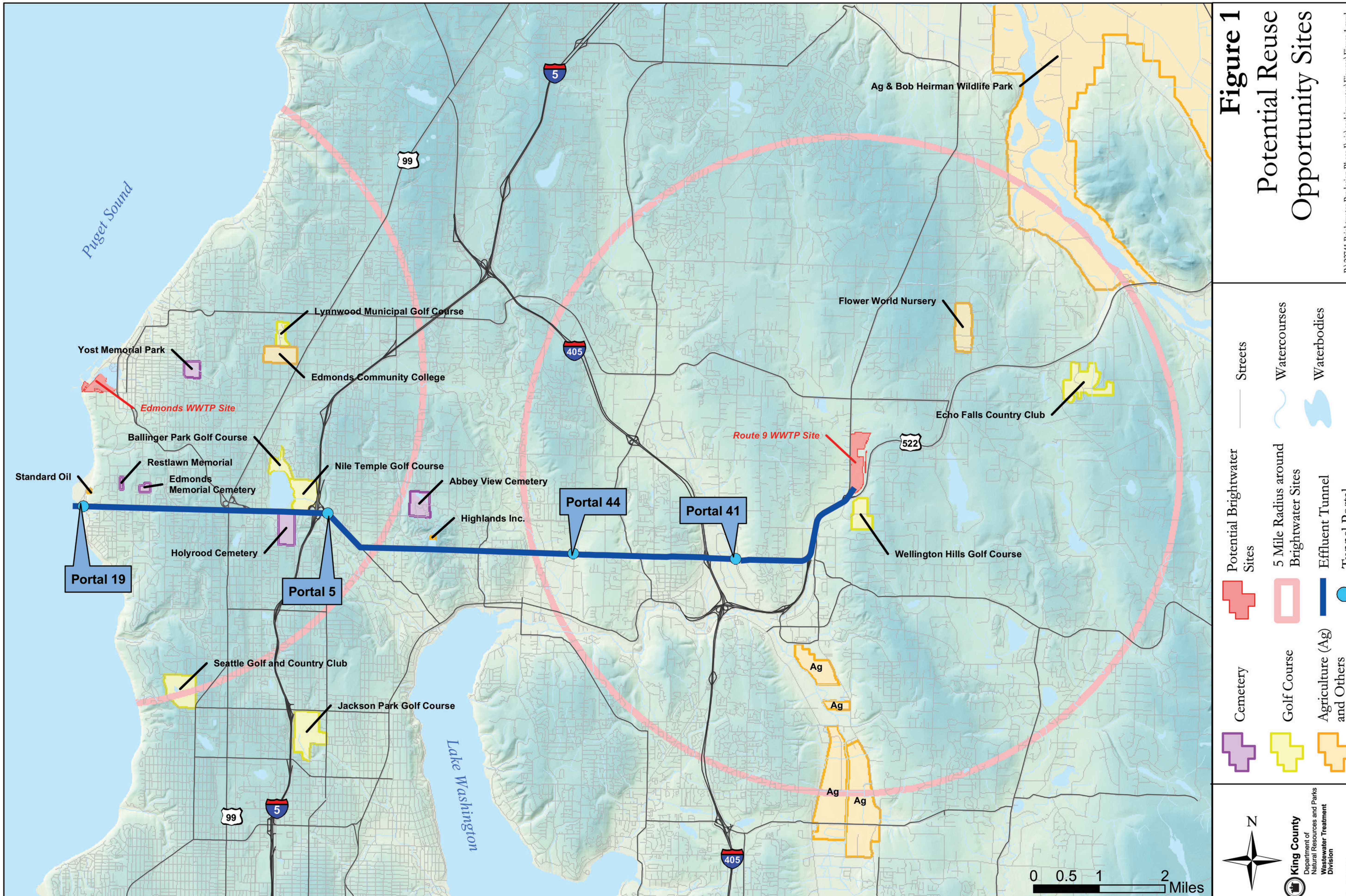

Figure 1
Potential Reuse Opportunity Sites
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Puget Sound
Lake Washington
Ag & Bob Heirman Wildlife Park
Flower World Nursery
Echo Falls Country Club
Route 9 WWTP Site
Wellington Hills Golf Course
Lynnwood Municipal Golf Course
Yost Memorial Park
Edmonds Community College
Edmonds WWTP Site
Ballinger Park Golf Course
Restlawn Memorial
Standard Oil
Edmonds Memorial Cemetery
Nile Temple Golf Course
Abbey View Cemetery
Highlands Inc.
Holyrood Cemetery
Portal 19
Portal 5
Portal 44
Portal 41
Seattle Golf and Country Club
Jackson Park Golf Course
Ag
Ag
Ag
Ag
5
99
405
522
Streets
Watercourses
Waterbodies
Potential Brightwater Sites
5 Mile Radius around Brightwater Sites
Effluent Tunnel
Tunnel Portal
Cemetery
Golf Course
Agriculture (Ag) and Others
N
0 0.5 1 2 Miles
King County
Department of Natural Resources and Parks
Wastewater Treatment Division
April 2003

Figure 2
Water Reuse Projects

Puget Sound

Lake Washington

Ag & Bob Heirman Wildlife Park
33.3 mgd

Flower World Nursery
1.0 mgd

Echo Falls Country Club
1.0 mgd

Wellington Hills Golf Course
0.7 mgd

Lynnwood Municipal Golf Course
0.6 mgd

Yost Memorial Park
0.3 mgd

Edmonds Community College
0.2 mgd

Edmonds WWTP Site

Ballinger Park Golf Course
0.4 mgd

Restlawn Memorial
0.3 mgd

Standard Oil
0.4 mgd

Edmonds
Memorial Cemetery
0.2 mgd

Nile Temple Golf Course
0.7 mgd

Abbey View Cemetery
1.1 mgd

Highlands Inc.
0.3 mgd

Holyrood Cemetery
0.3 mgd

Route 9 WWTP Site

Portal 19

Portal 5

Portal 44

Portal 41

Seattle Golf and Country Club
1.8 mgd

Jackson Park Golf Course
0.8 mgd

Ag

Ag

Ag
10.0 mgd

Ag

5

99

405

522

0 0.5 1 2 Miles

N

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Division

April 2003

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Streets
Watercourses
Waterbodies

Potential Brightwater Sites
5 Mile Radius around Brightwater Sites
Effluent Tunnel
Tunnel Portal

West Initial Reuse Sites
West Future Reuse Sites

Northeast Initial Reuse Sites
Northeast Future Reuse Sites
South Reuse Sites

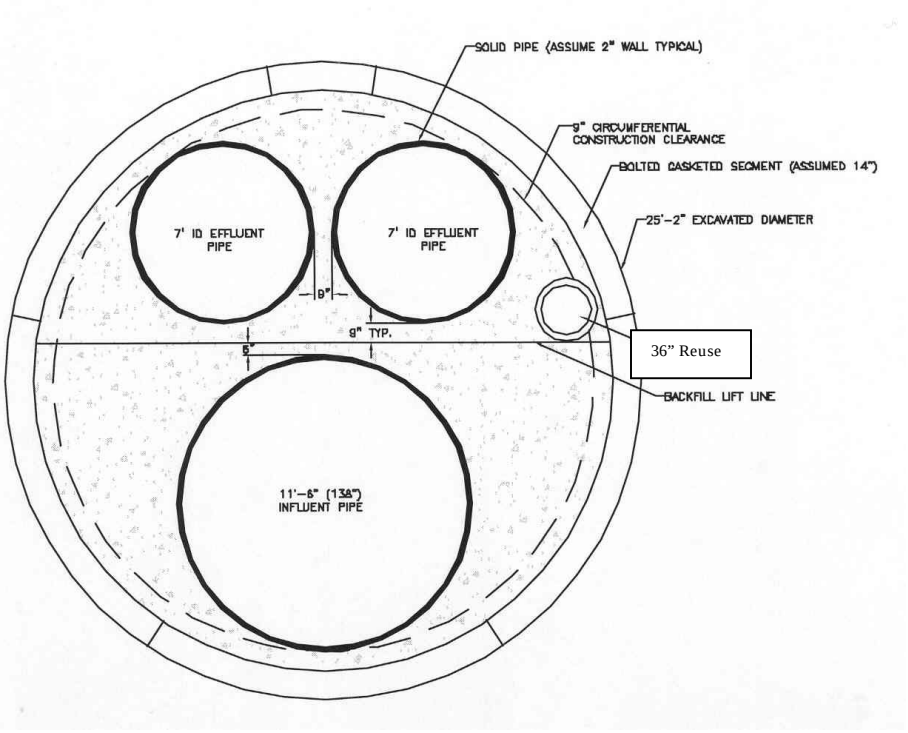


Figure 3. Typical Combined Tunnel Cross Section (Alternative 1)

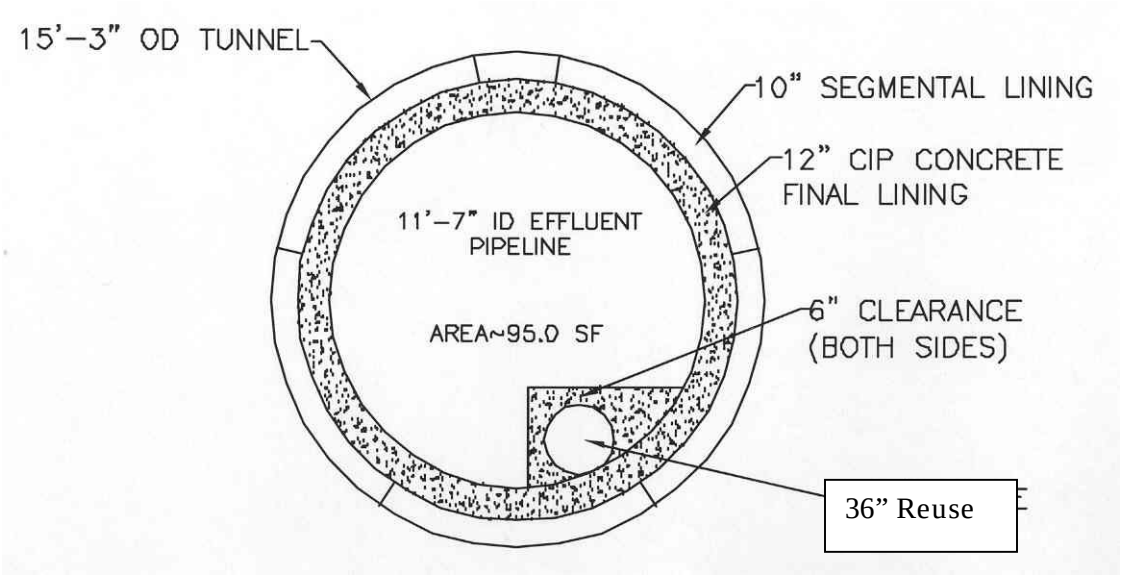
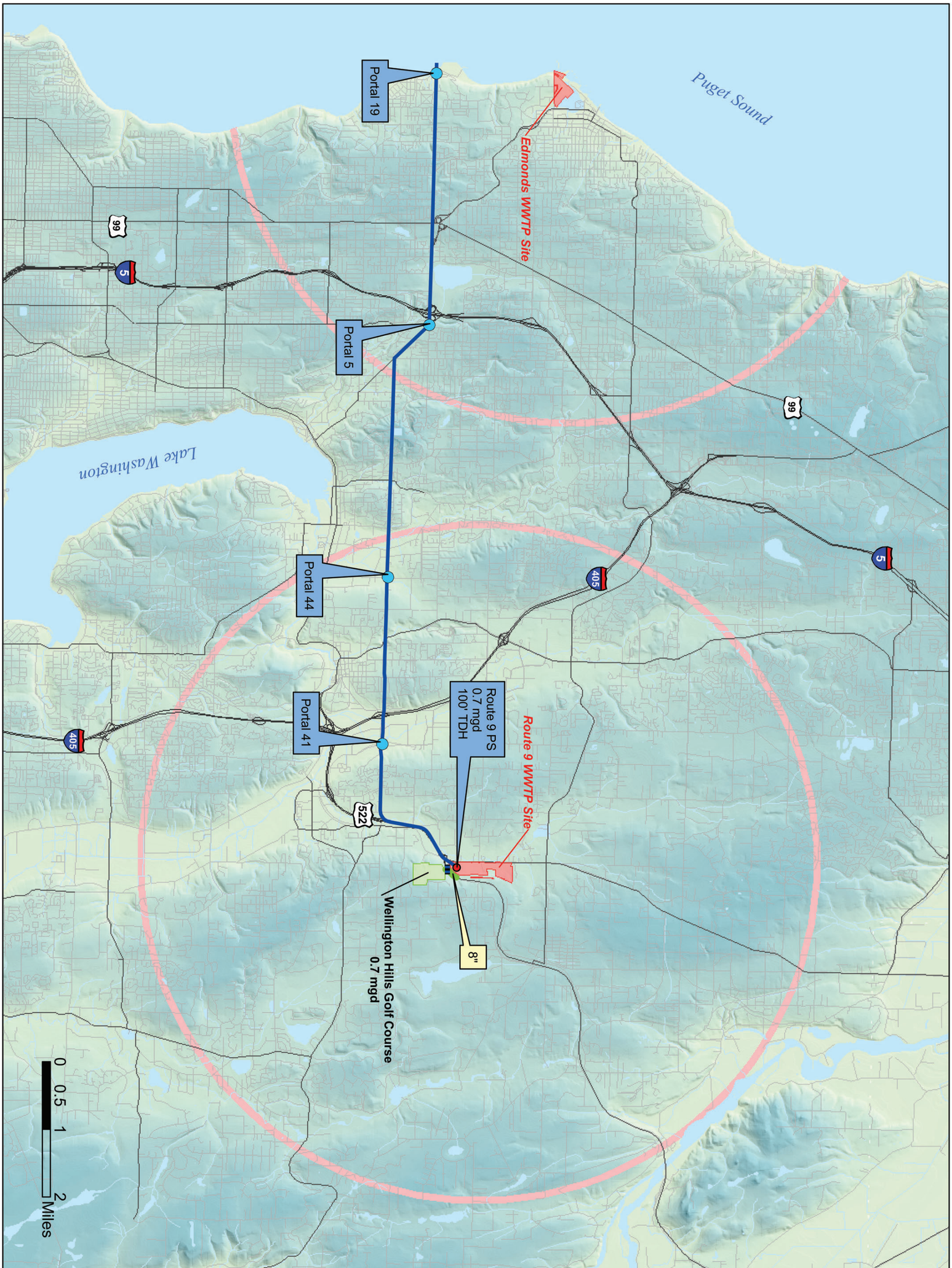


Figure 4. Typical Effluent Tunnel Cross Section (Alternative 3)



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Wastewater Treatment Division

April 2003

Wellington Hills Reuse Site

Potential Brightwater Sites

5 Mile Radius Around Brightwater Sites

Wellington Hills Reuse Pipe (Surface Alignment)

Pump Station

Effluent Tunnel

Tunnel Portal

8" Pipe Diameters

Special Crossings

Streets

Watercourses

Waterbodies

Figure 5

Wellington Hills Reuse Conveyance System Dedicated Reuse Pipe

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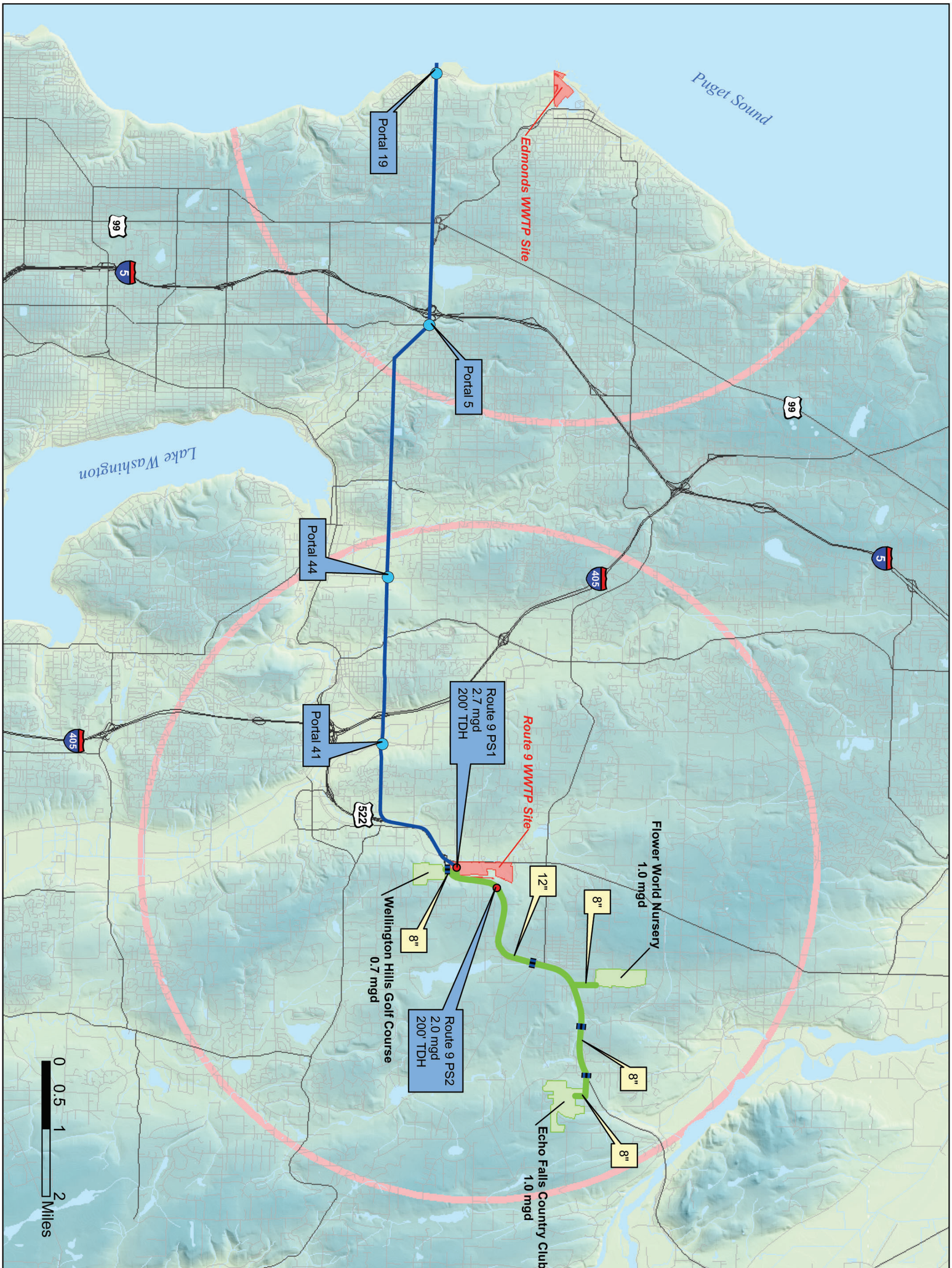

Figure 6

Northeast Initial Reuse Conveyance System Dedicated Reuse Pipe

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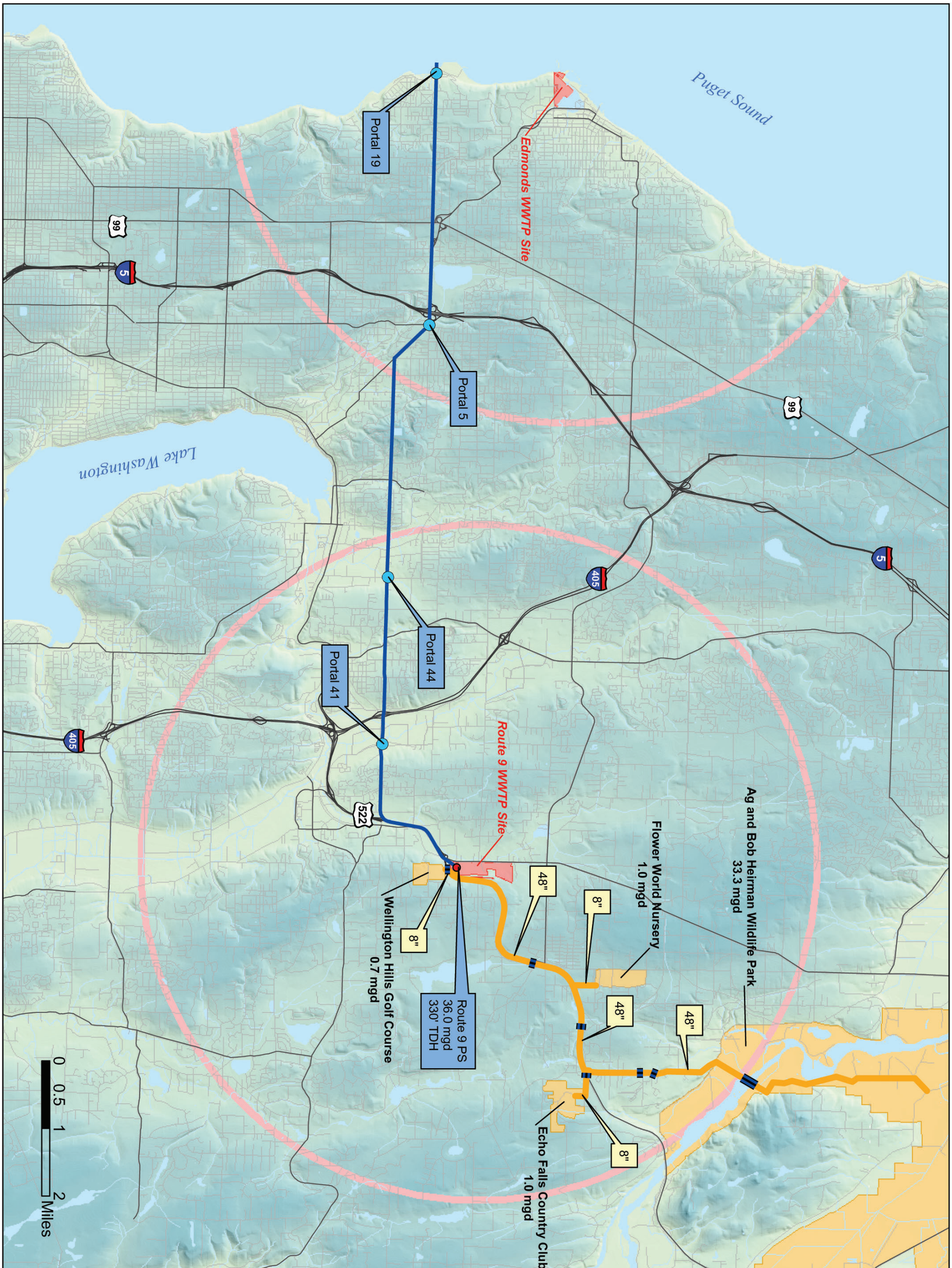

Figure 7
Northeast Future Reuse Conveyance System Dedicated Reuse Pipe

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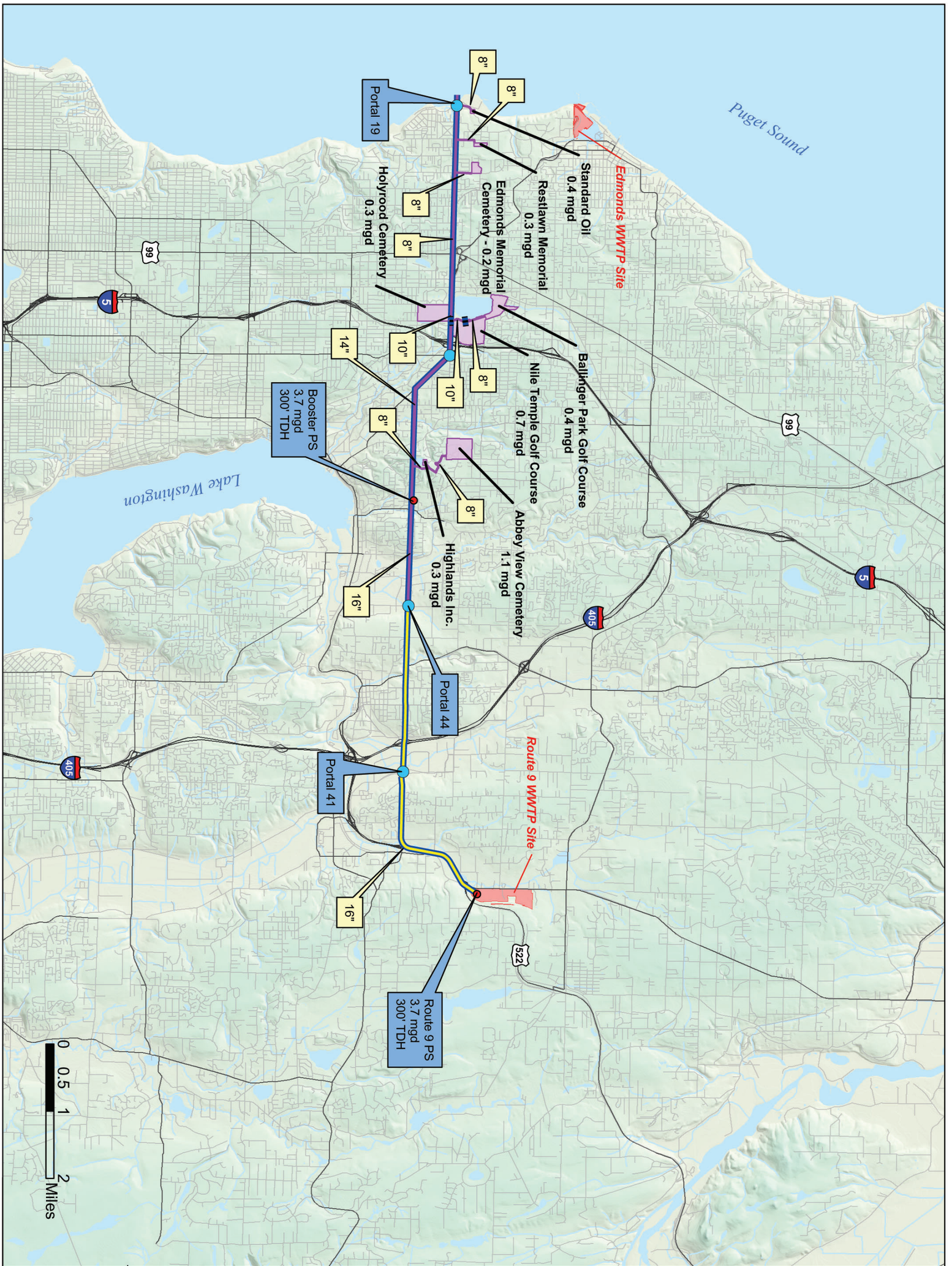

Figure 8
West Initial ALT 1 Reuse Conveyance System Dedicated Reuse Pipe

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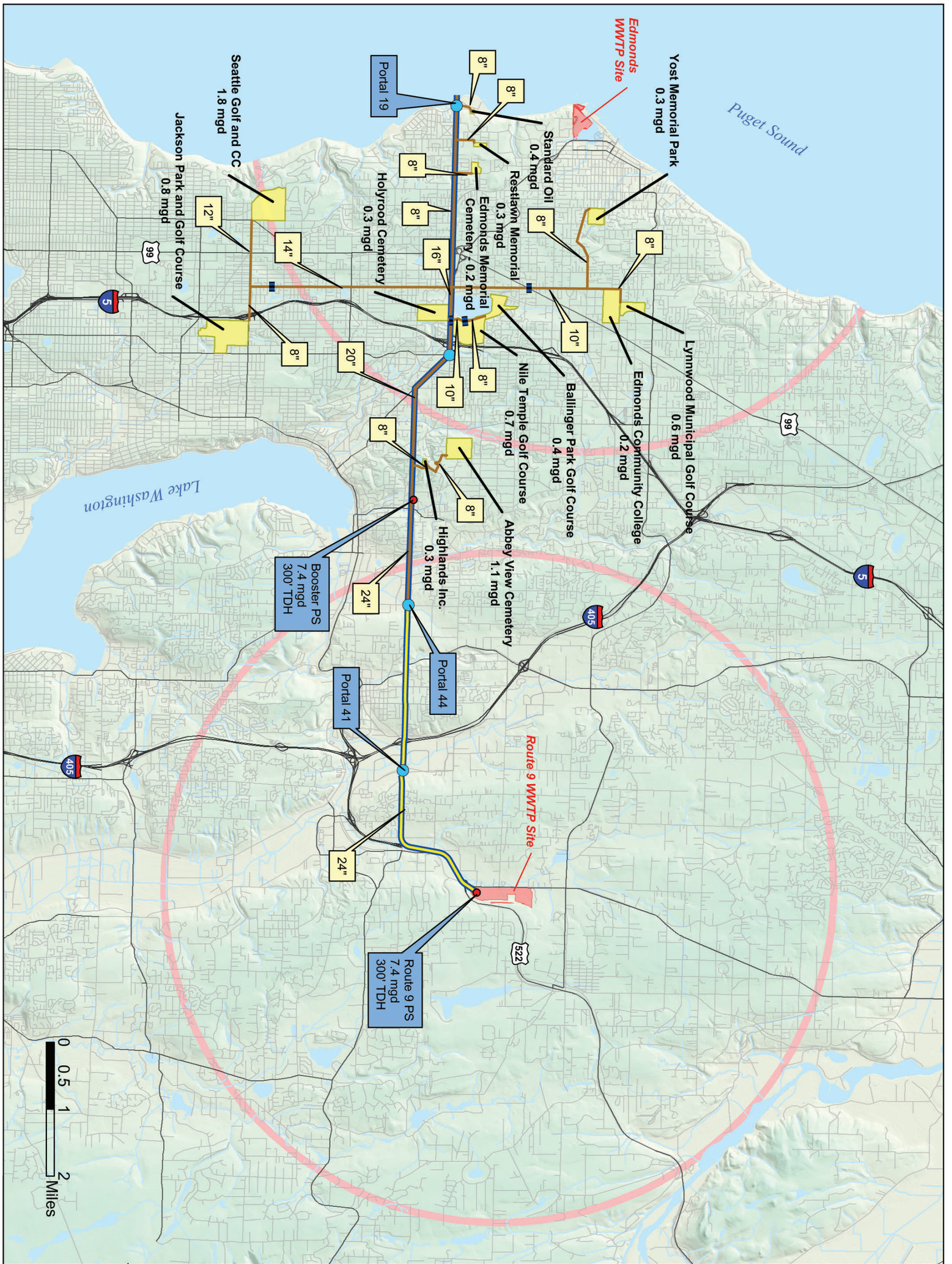

Figure 9

West Future ALT 1 Reuse Conveyance System Dedicated Reuse Pipe

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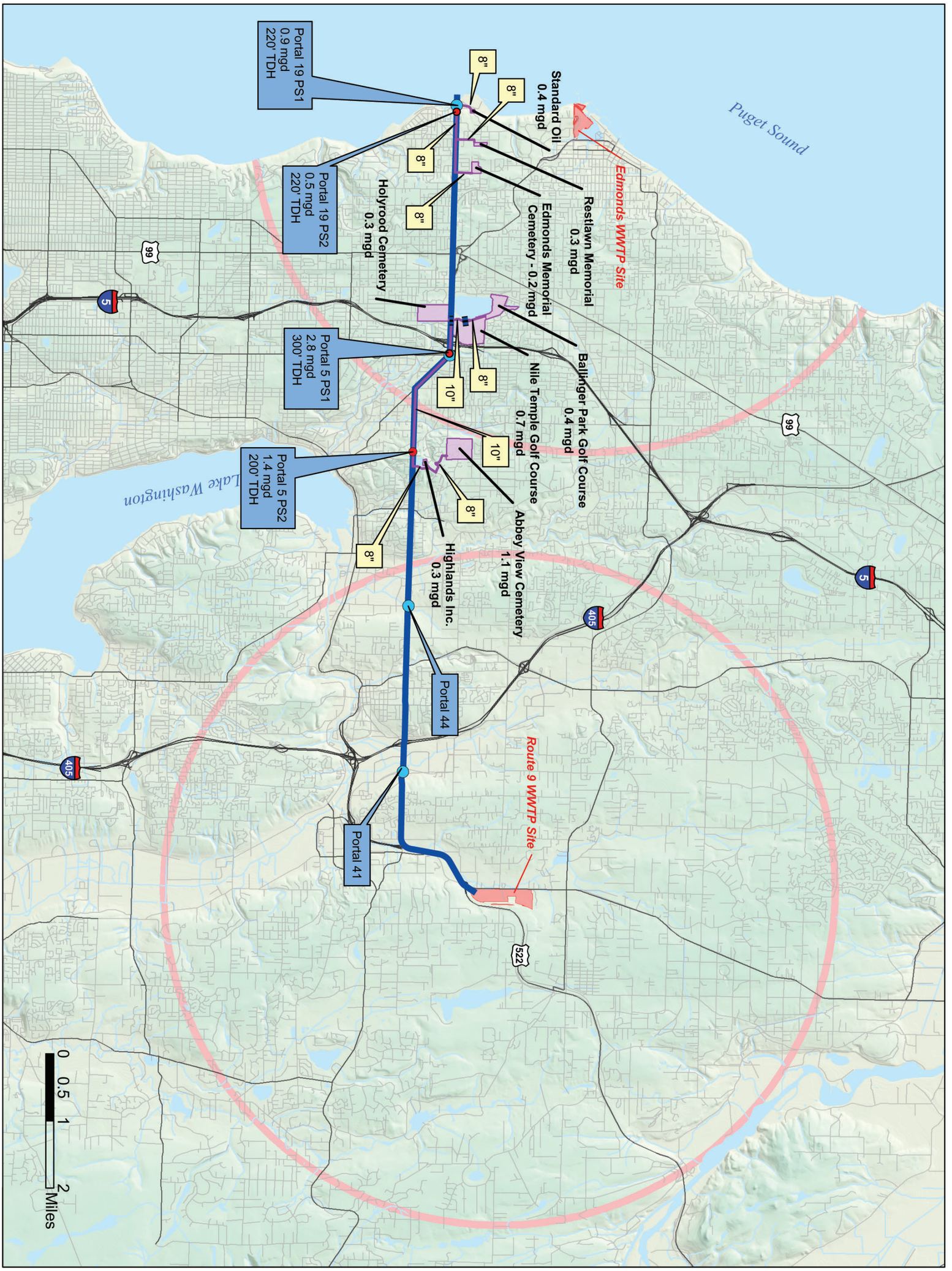

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Division

September 2003

- West Initial Reuse Sites
- Potential Brightwater Sites
- 5 Mile Radius Around Brightwater Sites
- West Initial Reuse Pipe (Surface Alignment)
- Pump Station
- Effluent Tunnel
- Tunnel Portal
- 8" Pipe Diameters
- Special Crossing
- Streets
- Watercourses
- Waterbodies

Figure 10

West Initial ALT 2 Reuse Conveyance System Direct Tunnel Withdrawal

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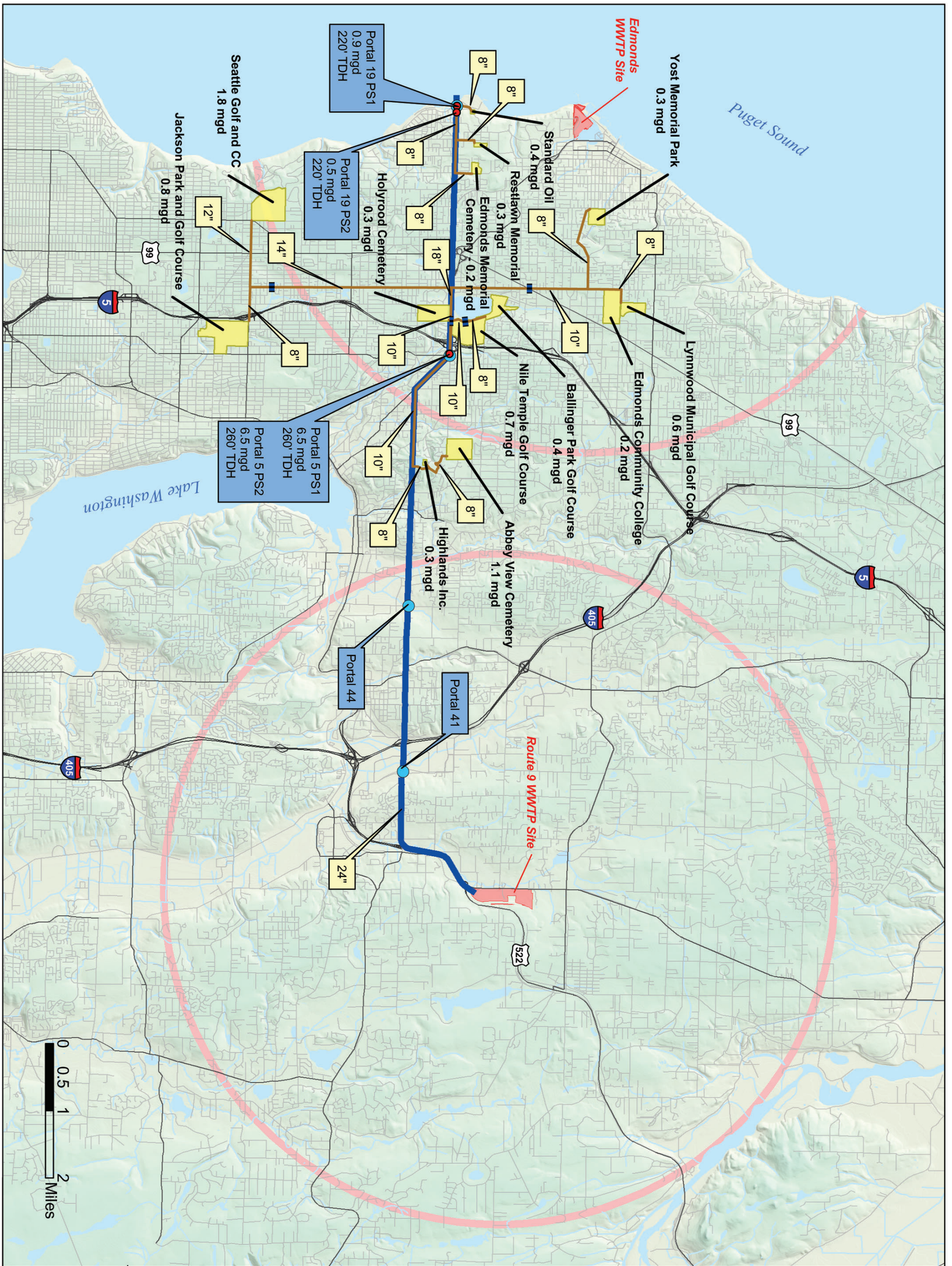

Figure 11

West Future ALT 2 Reuse Conveyance System Direct Tunnel Withdrawal

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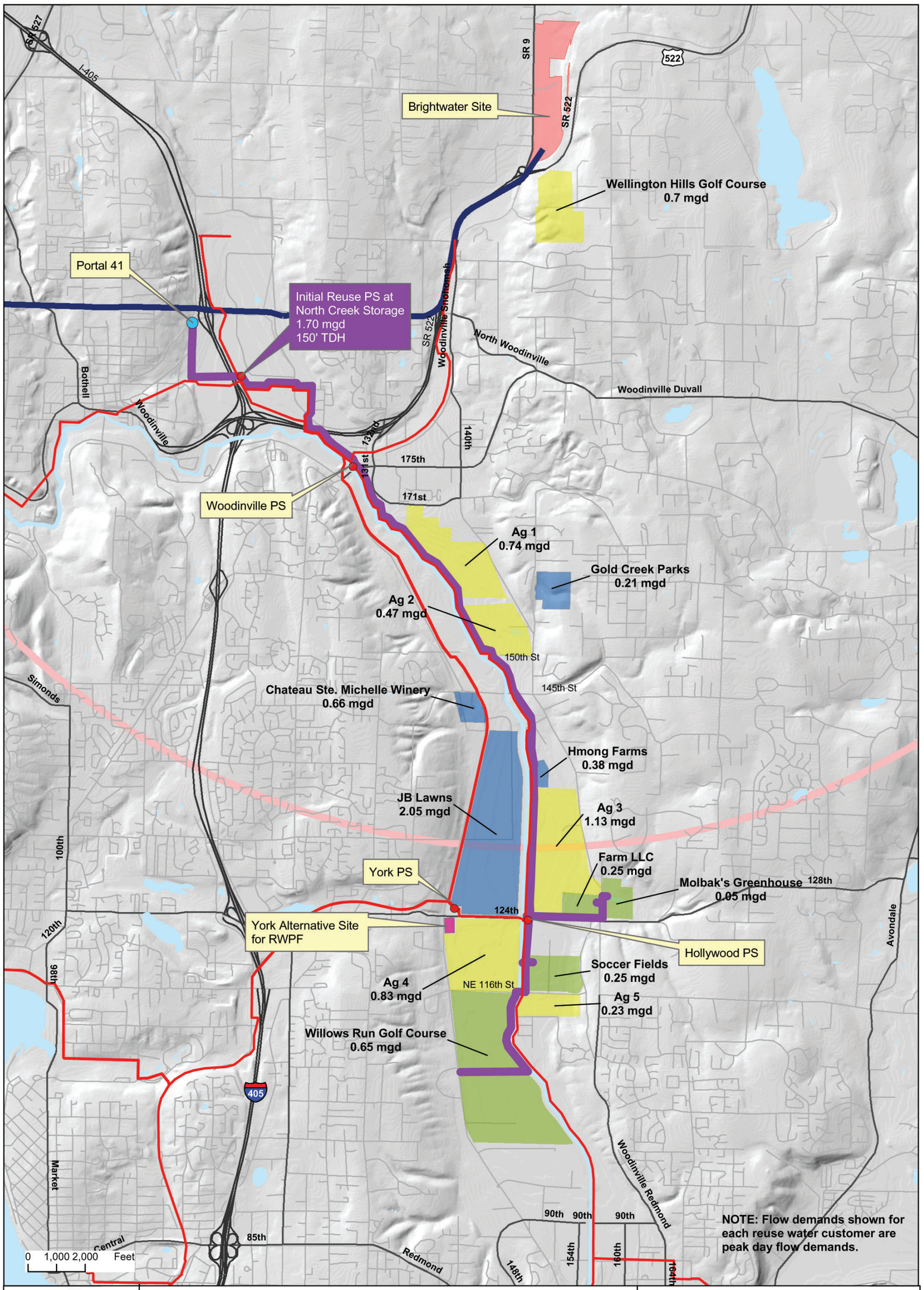
Brightwater Site
Wellington Hills Golf Course
0.7 mgd
Portal 41
Initial Reuse PS at
North Creek Storage
1.70 mgd
150' TDH
Woodinville PS
Ag 1
0.74 mgd
Gold Creek Parks
0.21 mgd
Ag 2
0.47 mgd
Chateau Ste. Michelle Winery
0.66 mgd
Hmong Farms
0.38 mgd
JB Lawns
2.05 mgd
Ag 3
1.13 mgd
Farm LLC
0.25 mgd
Molbak's Greenhouse
0.05 mgd
York PS
York Alternative Site
for RWPF
Hollywood PS
Soccer Fields
0.25 mgd
Ag 4
0.83 mgd
Ag 5
0.23 mgd
Willows Run Golf Course
0.65 mgd
NOTE: Flow demands shown for each reuse water customer are peak day flow demands.
0 1,000 2,000 Feet
N
King County
Department of Natural Resources and Parks
Wastewater Treatment Division
September 2003
Initial Sammamish Reuse Sites
Future Sammamish Reuse Sites
Potential Future Ag and Golf Reuse Sites
5-Mi Radius Around Brightwater
Effluent Tunnel
Tunnel Portal
Reuse Pipe
KC Sewer
Pump Station
Streets
Waterbodies
Figure 12
Alternative 2 - Initial Phase & Initial Phase A
Sammamish Valley Reclaimed Water
P:\22741 Brightwater Predesign Phase I\GIS\Reclaim Water\Figures\8-03\Figure 12.mxd

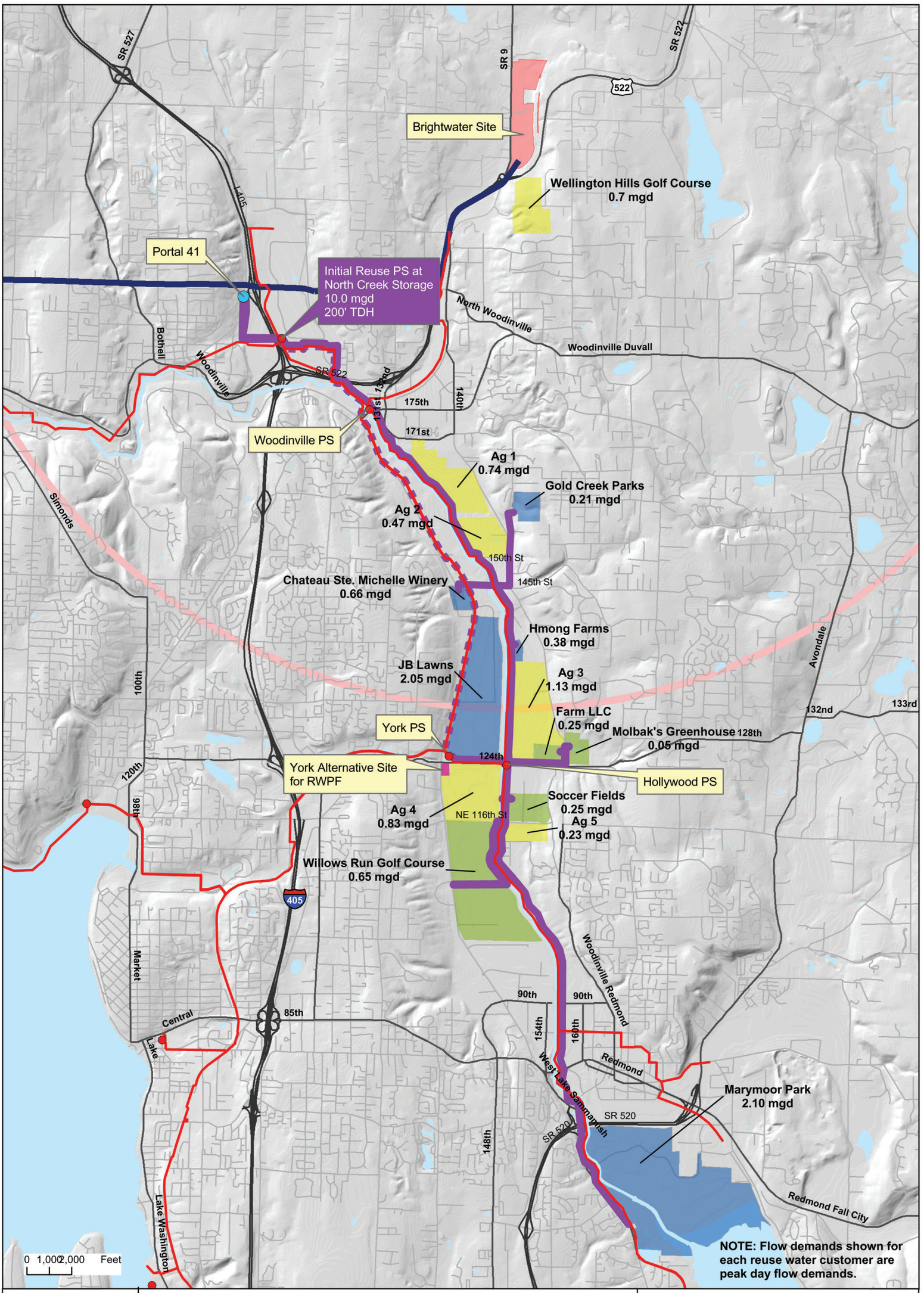

Figure 13
Alternative 2 - Future Phase

Sammamish Valley
Reclaimed Water

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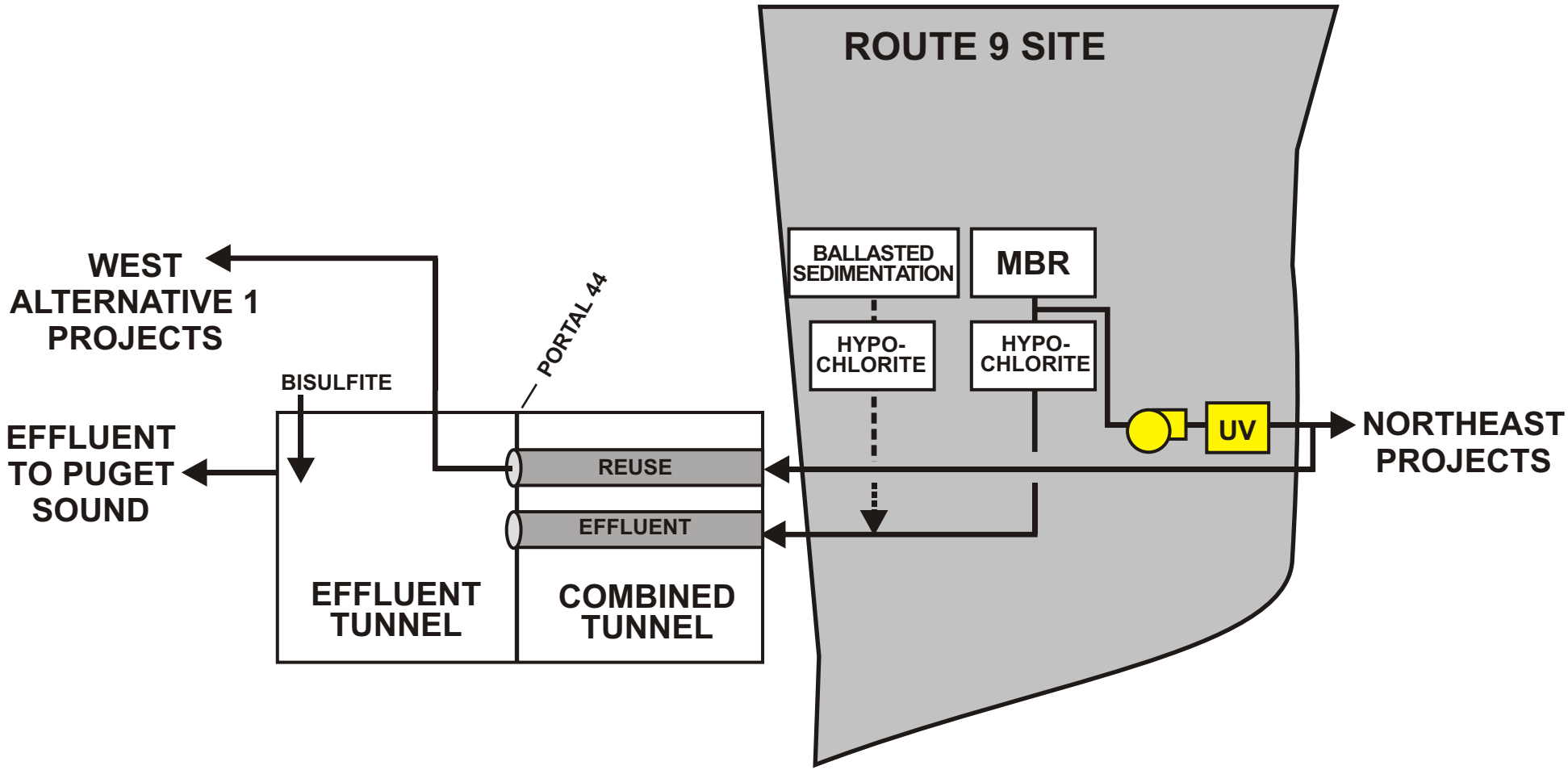


Figure 14. Northeast and West Alternative 1 (Dedicated Reuse Pipe) Schematic

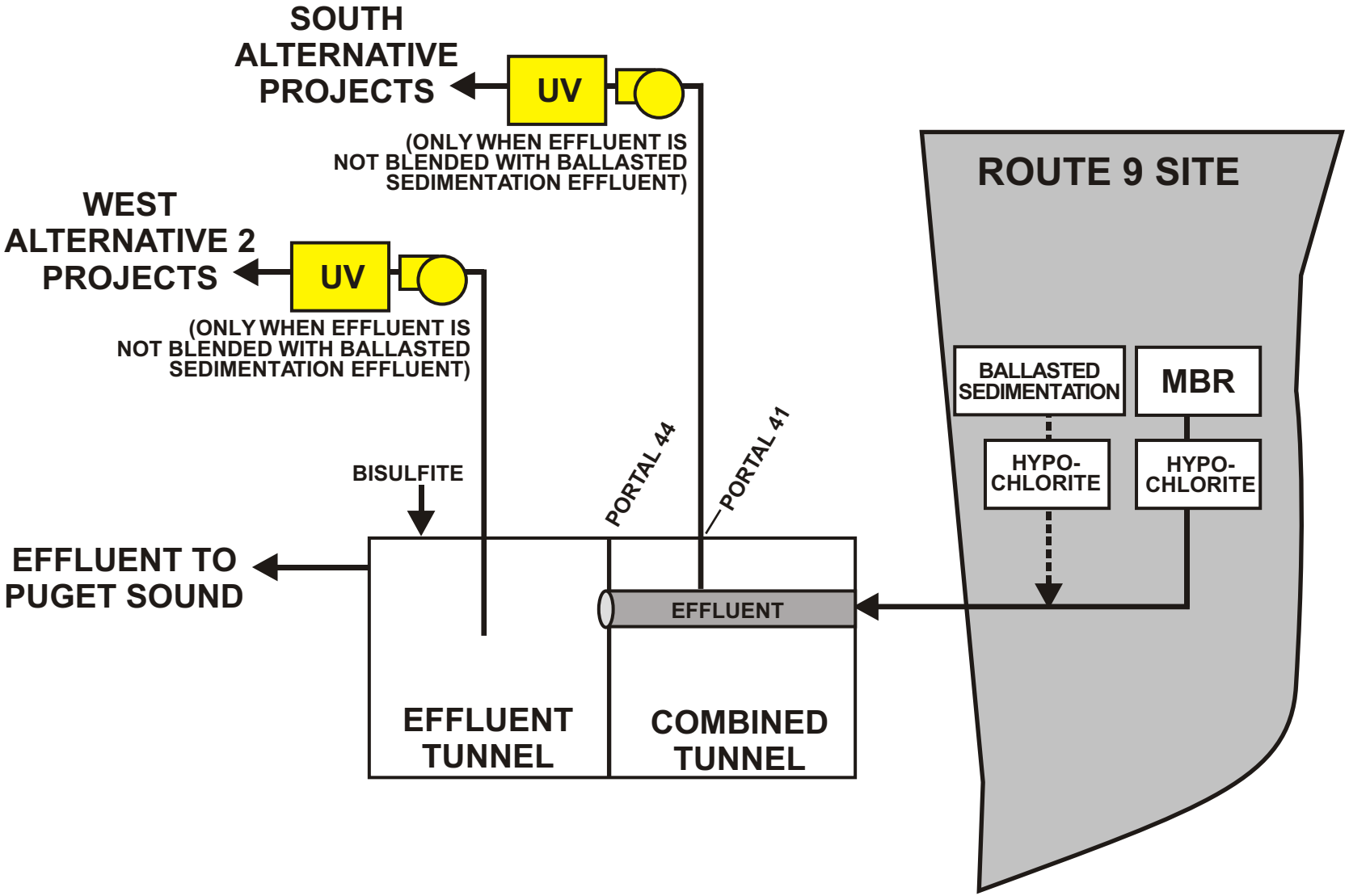


Figure 15. South Alternatives and West Alternative 2 (Direct Tunnel Withdrawal) Schematic

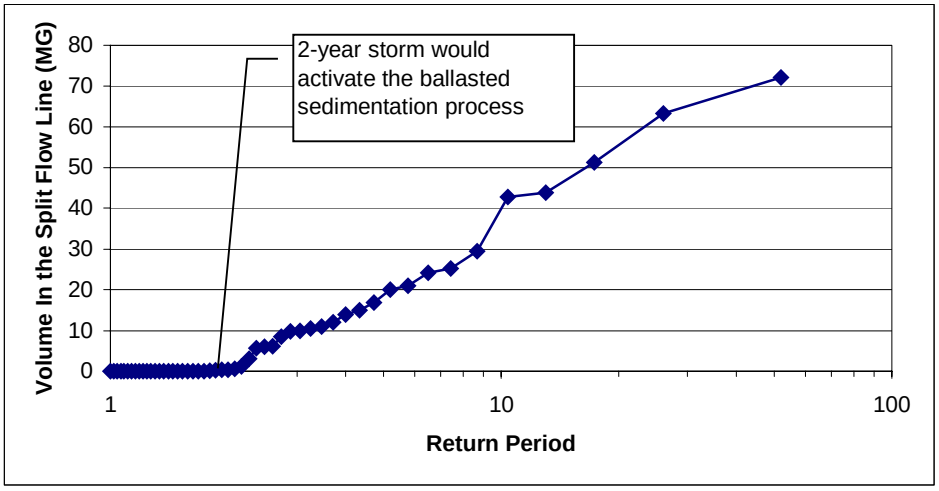


Figure 16. Frequency and Volume of Split Flow

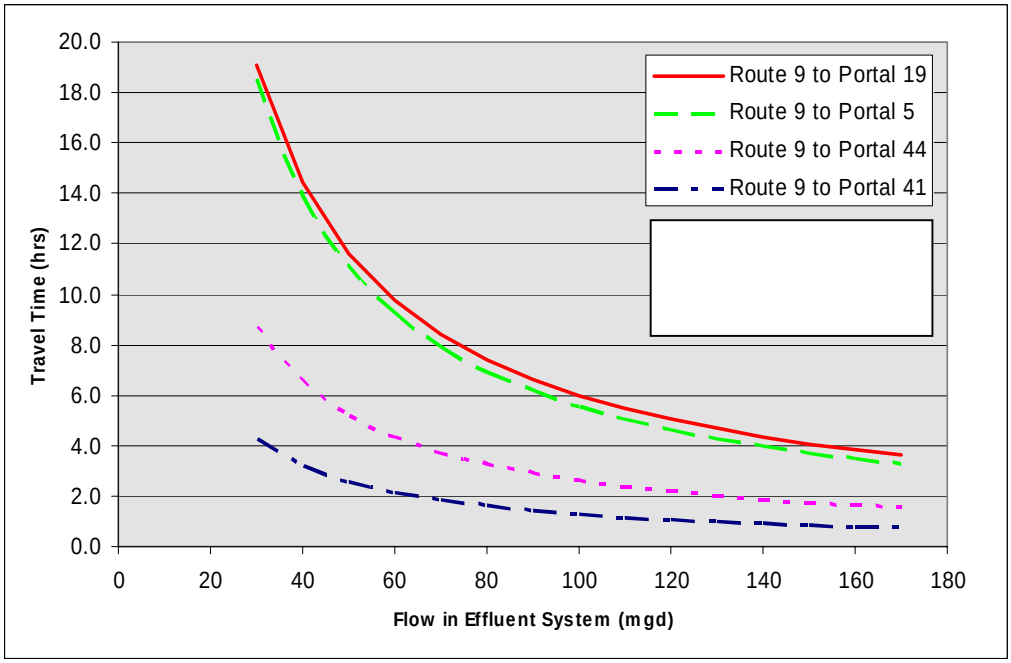


Figure 17. Travel Time in Effluent System

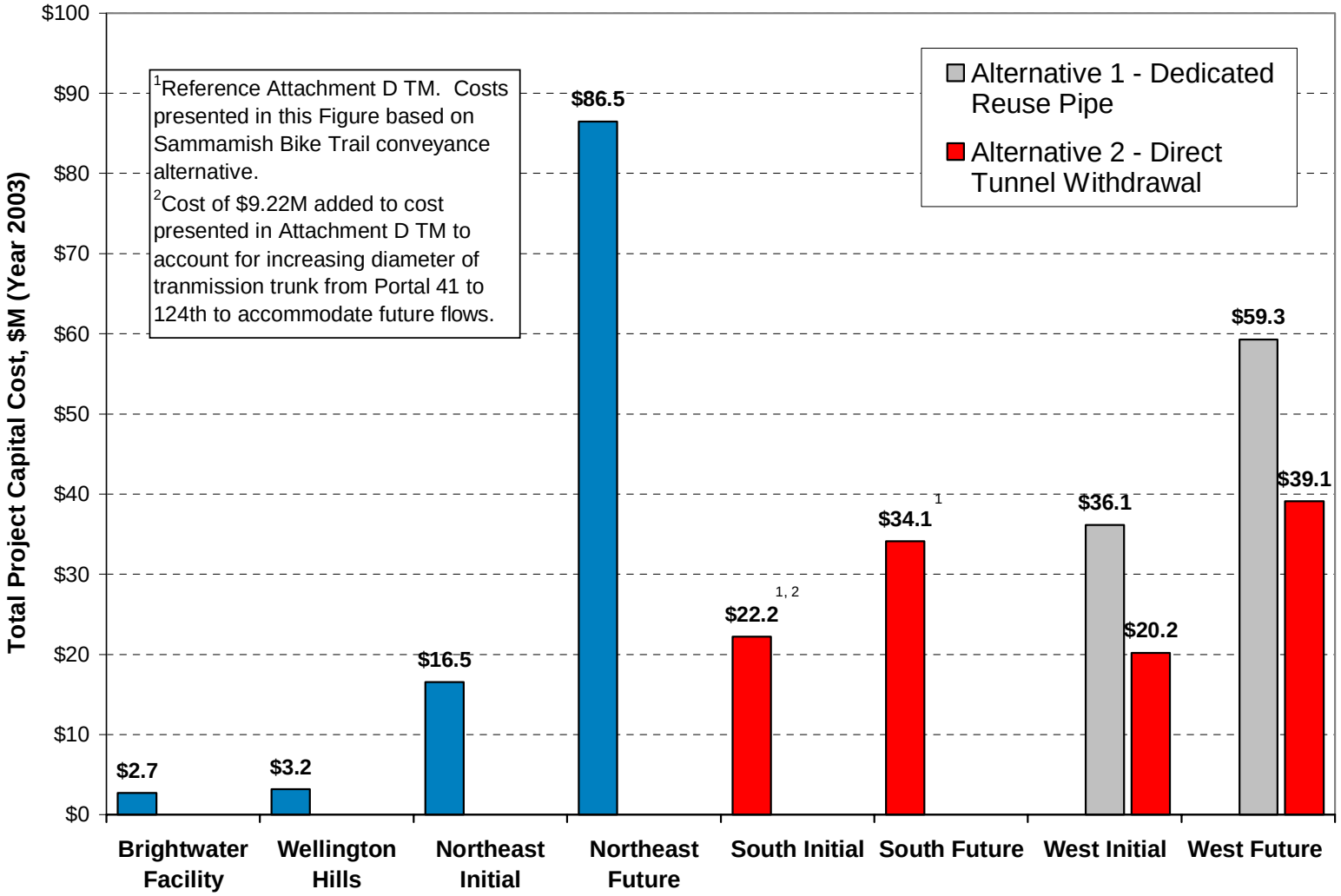


Figure 18: Total Project Capital Costs

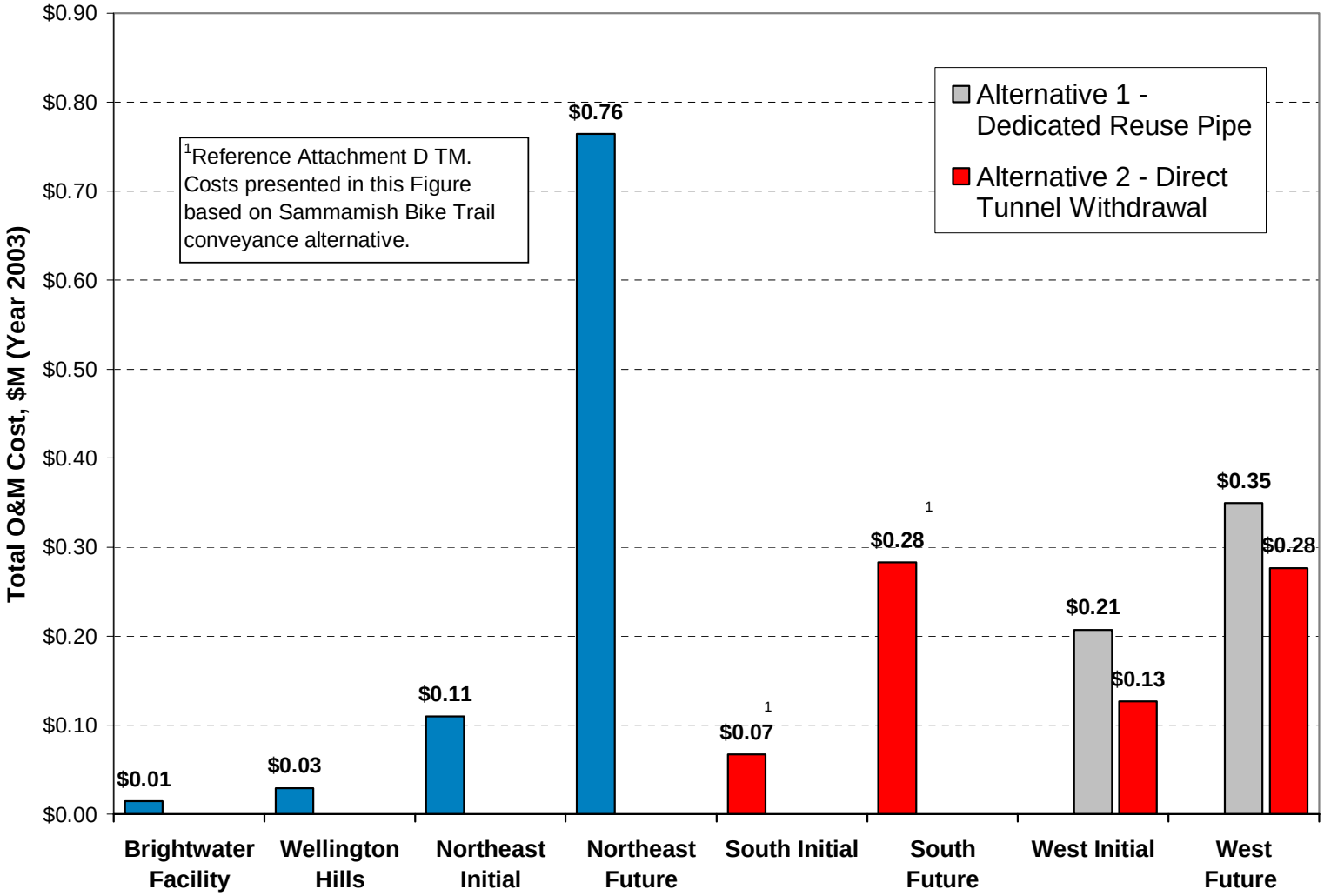


Figure 19: Total O&M Costs

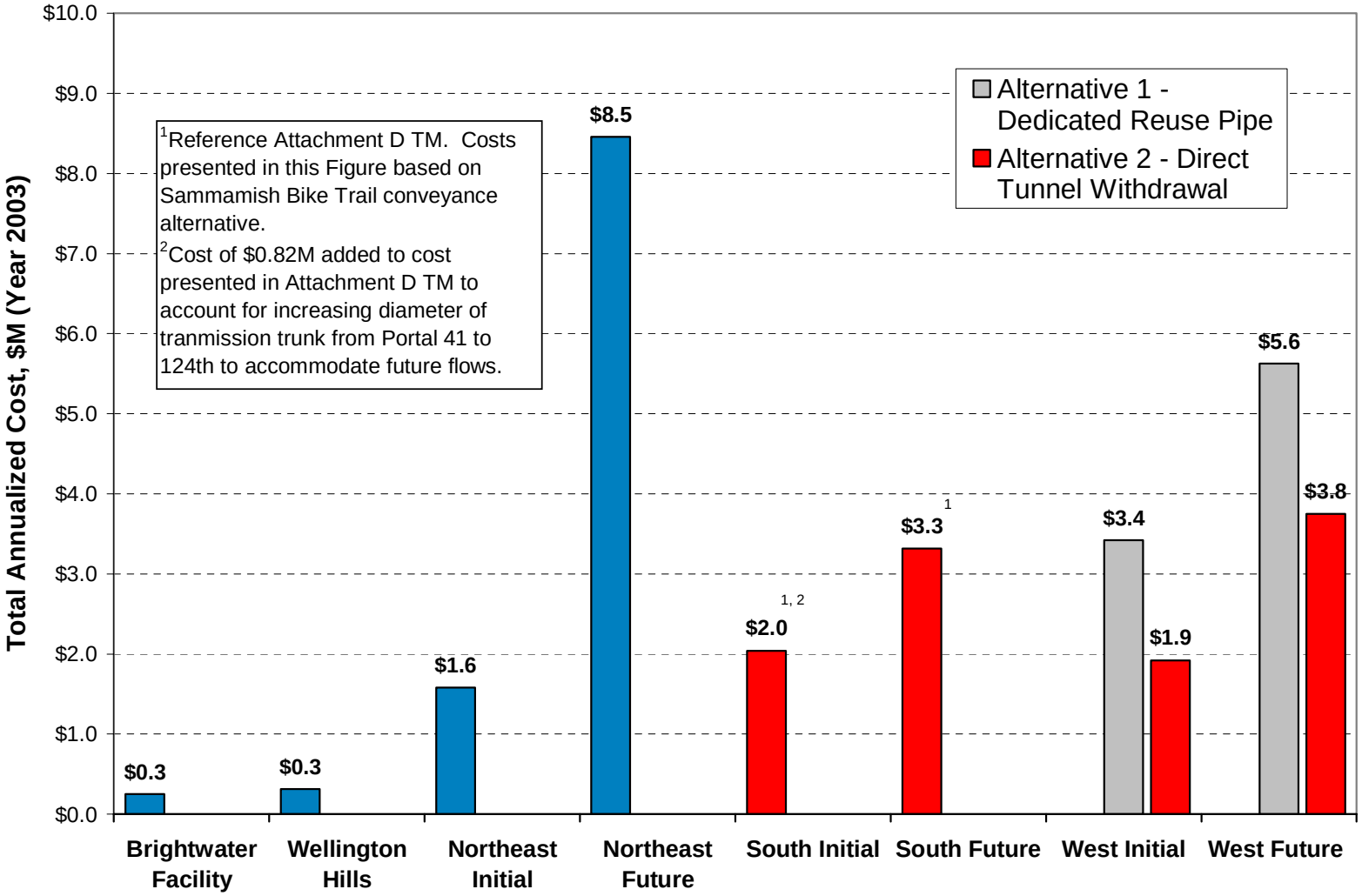


Figure 20: Total Annualized Cost

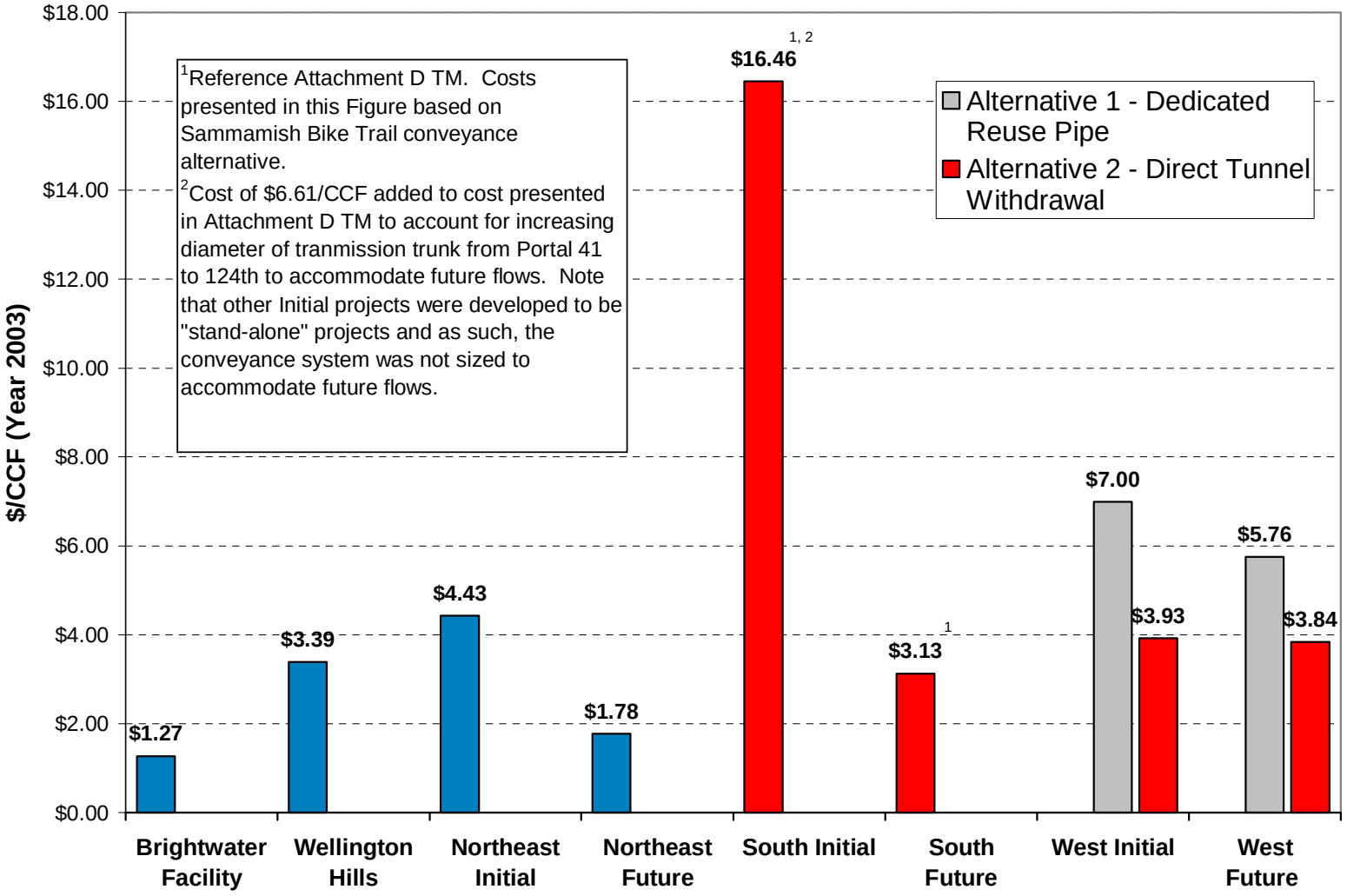


Figure 21: Levelized Unit Costs

ATTACHMENT A

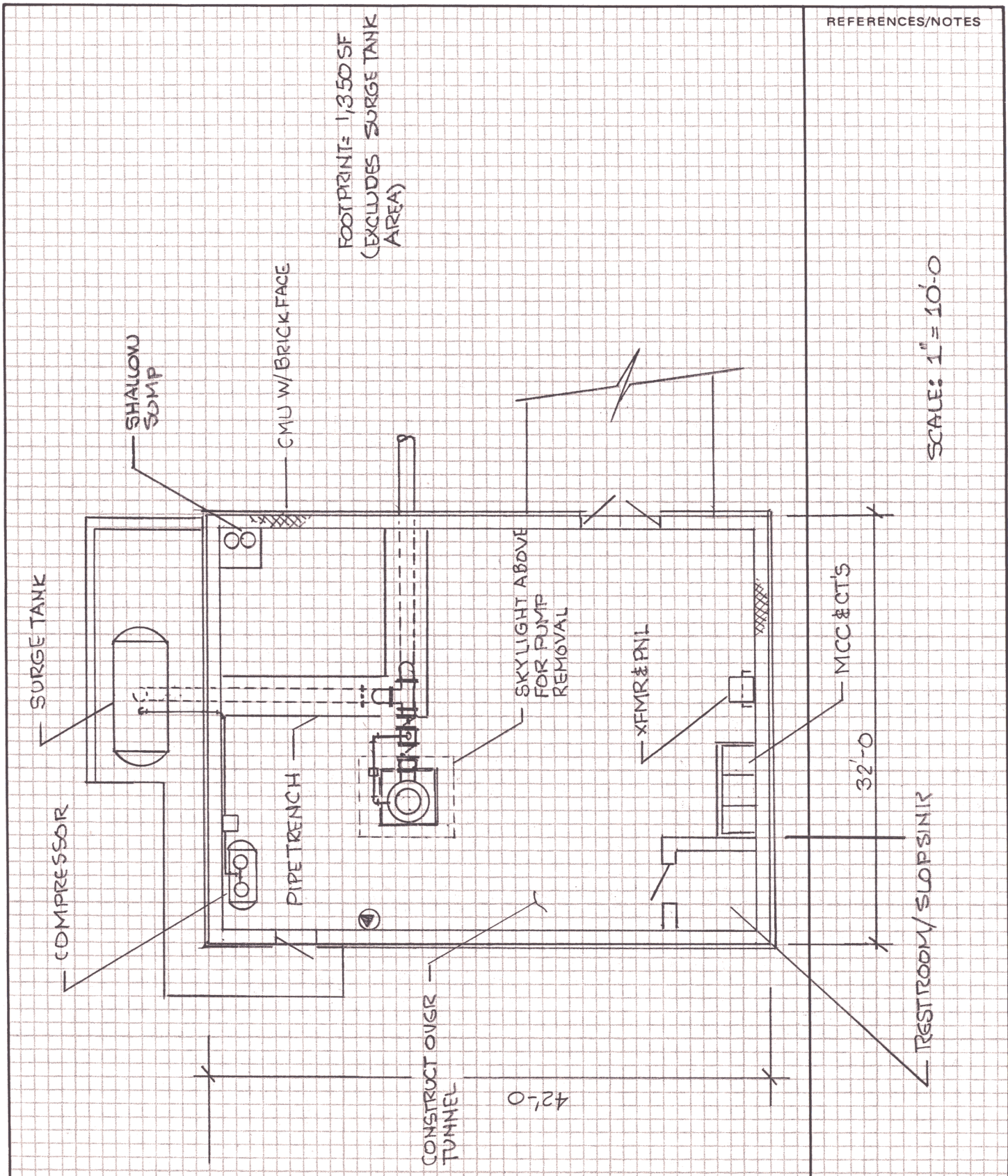
Sketches

Typical Reuse Water Pump Station Layout

Effluent Tunnel Pump Suction

Brown and Caldwell
Consultants

REFERENCES/NOTES

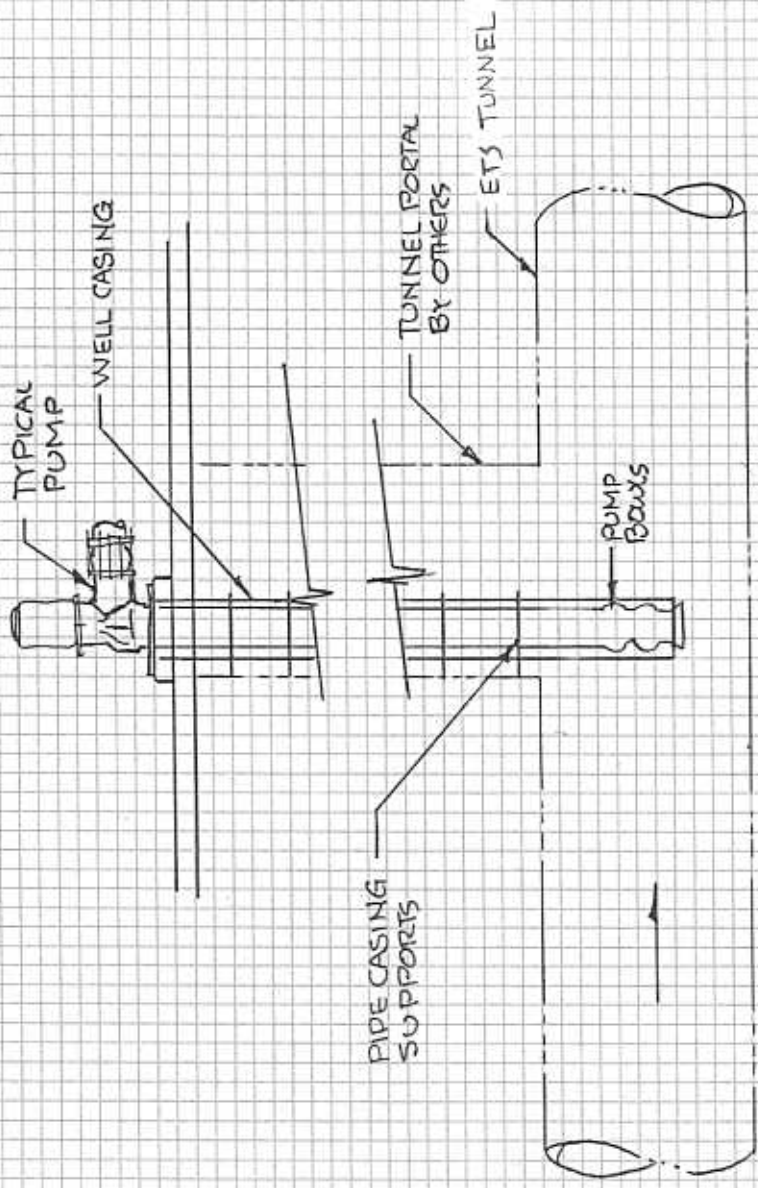


DATE CHECKED	CHECKED BY	JOB NUMBER	BY	DATE	CALC. NO.	SHEET NO.
2/11/03	B Penrod	22741	AGJ	2/5/03		

PROJECT	SUBJECT
Bright Water	Typical Reuse Water P.S.

BROWN AND CALDWELL

REFERENCES / NOTES



2/11/03	B. Pusich	22741.061	AGJ	1/22/03		SHEET NO.
DATE CHECKED	CHECKED BY	JOB NUMBER	BY	DATE	CALC. NO.	

BRIGHTWATER	EFFLUENT TUNNEL PUMP SUCTION
PROJECT	SUBJECT

ATTACHMENT B

Spreadsheets

Calculations

Cost Summary

Building Capital Cost

Pump Station Capital and O&M Cost

Conveyance Capital Cost

Special Crossing Cost

UV Disinfection Capital and O&M Cost

NOTE: Information included in Attachment B regarding South Projects has been superceded by information included in the Brightwater – Sammamish Reuse TM in Attachment D.

BROWN AND CALDWELL

OBJECTIVE
Calculate pump station requirements for each reclaim water alternative and identify pipe sections requiring special construction.

APPROACH
Use Hazen-Williams equation to determine friction losses for force mains.
$h_f = ((3.022)(v)^{1.85}L)/((C)^{1.85}(D)^{1.165})$

Assumptions
provide a minimum of 20 psi (46 feet water) to each demand point
peak velocity of 4 to 5 fps
max head per PS ~ 300 ft
use peak day demands as presented in Sep 10, 2002 Reclaim Water memo (Table 2)

CALCULATIONS

Conveyance

Velocity (fps)	4	(used for "Calc'd. Diameter")
Hazen-Williams "C"	130	

Reuse Water Pipe	[1]Peak Day Demand (mgd)	Flow in Pipe (mgd)	Length (ft)	Calc'd. Diameter (in)	[2]Actual Diameter (in)	Actual Velocity (fps)	h_f (ft)
Northeast Initial	**2.7**						
Northeast Initial Trunk 1		2.0	15,600	11.9	12	3.9	73
Northeast Initial Trunk 2		1.0	7,000	8.4	8	4.4	66
Wellington Golf Course	0.7	0.7	1,200	7.0	8	3.1	6
Flower World	1.0	1.0	1,900	8.4	8	4.4	18
Echo Falls Country Club	1.0	1.0	2,800	8.4	8	4.4	26
Wellington Hills	**0.7**	0.7	2,000	7.0	8	3.1	10
Northeast Future	**36.0**						
Northeast Future Trunk 1		35.3	15,600	50.0	48	4.3	17
Northeast Future Trunk 2		34.3	7,000	49.3	48	4.2	7
Wellington Golf Course	0.7	0.7	1,200	7.0	8	3.1	6
Flower World	1.0	1.0	1,900	8.4	8	4.4	18
Echo Falls Country Club	1.0	1.0	2,800	8.4	8	4.4	26
Ag & Bob Heirman WL Park	33.3	33.3	28,900	48.6	48	4.1	29
South Alt 1	**10.0**	10.0	24,100	26.6	30	3.2	26
West Initial Alt 1	**3.7**						
Portal 5 East Trunk		1.4	11,200	10.0	10	4.0	66
Highlands, Inc.	0.3	0.3	350	4.6	8	1.3	0
Abbey View Cemetery	1.1	1.1	2,800	8.8	8	4.9	31
Portal 5 West Trunk WI		1.4	2,700	10.0	10	4.0	16
Ballinger Park Golf Course	0.4	0.4	1,300	5.3	8	1.8	2
Nile Temple Golf Course	0.7	1.1	1,700	8.8	10	3.1	6
Holyrood Cemetery	0.3	0.3	200	4.6	8	1.3	0
Portal 19 Trunk		0.5	2,700	6.0	8	2.2	7
Edmonds Memorial Cemetery	0.2	0.2	3,900	3.8	8	0.9	2
Restlawn Memorial Gardens	0.3	0.3	1,700	4.6	8	1.3	2
Standard Oil of California	0.4	0.4	1,400	5.3	8	1.8	2
West Future Alt 1	**7.4**						
Portal 5 West Trunk WF		4.4	2,700	17.7	18	3.9	8
Portal 5 South Trunk		2.6	16,000	13.6	14	3.8	58
Jackson Park Golf Course	0.8	0.8	2,700	7.5	8	3.5	17
Seattle Golf & Country Club	1.8	1.8	5,300	11.3	12	3.5	20
Portal 5 North Trunk		1.1	10,800	8.8	10	3.1	41
Yost Memorial Park	0.3	0.3	6,900	4.6	8	1.3	7
Edmonds Community College	0.2	0.8	1,400	7.5	8	3.5	9
Lynnwood Municipal Golf	0.6	0.6	2,400	6.5	8	2.7	9
West Initial	3.7		29,950				135
		Total Length	159,650				
Combined Tunnel & Surface Alignment Reuse Pipe Forcemain							
Combined Tunnel Reuse Pipe to 41 WI		3.7	12,700	16.2	16	4.1	46
Combined Tunnel Reuse Pipe to 44 WI		3.7	13,000	16.2	16	4.1	47
Surface from 44 to Highland WI		3.7	11,000	16.2	16	4.1	40
Surface from Highland to 5 WI		2.3	10,000	12.8	14	3.3	29
Surface from 5 to 19 WI		0.9	20,000	8.0	8	4.0	154
Combined Tunnel Reuse Pipe to 41 WF		7.4	12,700	22.9	24	3.6	23
Combined Tunnel Reuse Pipe to 44 WF		7.4	13,000	22.9	24	3.6	24
Surface from 44 to Highland WF		7.4	11,000	22.9	24	3.6	20
Surface from Highland to 5 WF		6.0	10,000	20.6	20	4.3	30
Surface from 5 to 19 WF		0.9	20,000	8.0	8	4.0	154
Combined Tunnel Reuse Pipe to 41 South		10.0	12,700	26.6	30	3.2	14

[1]Peak day demand values referenced from September 10, 2002 memo titled "Brightwater Predesign Phase 1, Task 1.06.01 and 1.06.02: Identify Reclaimed Use Opportunities and Evaluate Short-Term Sites" except for South, Echo Falls Country Club, and Abbey View Cemetery demands which were provided by Tom Fox with King County.

[2]Per Tabula, these are the following options for force main diameters…8,10,12,14,16,18,20,24,30,36,42,48,54,60. Assume minimum pipe diameter is 8".

		22741/061	TCG	April 28, 2003		
Date Checked	Checked By	Job No.	By	Date	Calc. No.	Sheet
Brightwater		**Reuse Water Calculations**				
Project		Subject				

Pumping Stations

Pumping Station	Location	[2]Tunnel Depth	PS Elev (ft)	[2]TDH (ft)	Peak Day Flow (mgd)
Dedicated Reuse Pipe					
Northeast Initial					
Route 9 PS 1 NEI	Route 9 Site	0	165	200	2.7
Route 9 PS 2 NEI	4,000' DS of Route 9		305	200	2.0
Northeast Future					
Route 9 PS NEF	Route 9 Site	0	165	330	36.0
Wellington Hills					
Route 9 PS Wellington Hills	Route 9 Site	0	165	100	0.7
South Alt 1					
Route 9 PS South	Route 9 Site	0	165	150	10.0
West Initial Alt 1					
Route 9 PS WI	Route 9 Site	0	165	300	3.7
Booster WI	37,000' DS of Rt 9		500	300	3.7
West Future Alt 1					
Route 9 PS WF	Route 9 Site	0	165	300	7.4
Booster WF	37,000' DS of Rt 9		500	300	7.4
Direct Withdrawal from Tunnel					
West Initial Alt 2					
Portal 19 PS 1 WI	Portal 19	50	18	220	0.9
Portal 19 PS 2 WI	2,000' DS of Portal 19		93	220	0.5
Portal 5 PS 1 WI	Portal 5	175	315	300	2.8
Portal 5 PS 2 WI	8,000' East of Portal 5		330	200	1.4
West Future Alt 2					
Portal 19 PS 1 WF	Portal 19	50	18	220	0.9
Portal 19 PS 2 WF	2,000' DS of Portal 19		93	220	0.5
Portal 5 PS 1 WF	Portal 5	175	315	250	6.5
Portal 5 PS 2 WF	Portal 5		330	250	6.5
South Alt 2					
Portal 41 PS South	Portal 41	50	50	150	10.0

[1]From TDH refinement based on profiles.
[2]From profile Edith Hadler with HDR titled "Route 9 195th Alt C2 (March 31, 2003)

Crossings

It is assumed that pipe sections crossing streams, wetlands, freeways, major arterials and streets, and railroads would be installed using microtunneling or pipe jacking.

The following assumptions were used for the Brightwater siting and are referenced in "Phase 2 Technical Documentation" memo dated September 2001. The same assumptions will be used for the reclaimed water conveyance.

Crossing Type	Right-of-Way (ROW) Requirements
Freeways/Major Arterials	ROW Length: 400 feet (includes 100 feet setback for contingency)
Other Major Streets	ROW Length: 300 feet (includes 100 feet setback for contingency)
Streams/Wetlands	ROW Length: 450 feet (50 foot corridor and 200 foot setback on each side of stream/wetland)

The following table summarizes crossings identified with GIS that would require pipe installation by microtunneling or pipe jacking. No field visit has been completed to evaluate alignments and verify significant crossings.

Crossing	Pipe	Type	Length (ft)	Diameter (in)	
West Nearby 205th	Nile Temple Golf Course	Major Street	300	10	
West Nearby Stream	Nile Temple Golf Course	Stream	450	10	
West Outer SR 99	Portal 5 North Trunk	Major Arterial	400	10	
West Outer Stream	Portal 5 South Trunk	Stream	450	14	
South SR 522	South Alt 1	Freeway	400	30	
South Samm River	South Alt 1	Stream	450	30	
South Stream 2	South Alt 1	Stream	450	30	
South Stream 3	South Alt 1	Stream	450	30	
South Stream 4	South Alt 1	Stream	450	30	
South Stream 5	South Alt 1	Stream	450	30	
South Stream 6	South Alt 1	Stream	450	30	
Northeast SR 522 (1)	Wellington Golf Course	Freeway	400	8	
Northeast SR 522 (2)	Echo Falls Country Club	Freeway	400	8	
Northeast Stream 1	Northeast Initial Trunk 1	Stream	450	12	
Northeast Stream 2	Northeast Initial Trunk 2	Stream	450	8	
Northeast Stream 1	Northeast Future Trunk 1	Stream	450	48	
Northeast Stream 2	Northeast Future Trunk 2	Stream	450	48	
Northeast Stream 3	Ag & Bob Heirman WL Park	Stream	450	48	
Northeast Stream 4	Ag & Bob Heirman WL Park	Stream	450	48	
Northeast Stream 5	Ag & Bob Heirman WL Park	Stream	1250	48	Snohomish River

	Total Length (ft)
Nile Temple Golf Course	750
Portal 27 North Trunk	400
Portal 27 South Trunk	450
South Alt 1	3,100
South Alt 2	3,100
Wellington Golf Course	400
Echo Falls Country Club	400
Northeast Initial Trunk 1	450
Northeast Initial Trunk 2	450
Northeast Future Trunk 1	450
Northeast Future Trunk 2	450
Ag & Bob Heirman WL Park	2150

REUSE WATER COST SUMMARY

	Assumption	Comment
Sales Tax	8.9%	
Allied Costs	35.0%	
Contingency	25.0%	
Contractor OH & Profit	18.0%	per Gene Johnson
Discount Rate	3.0%	per Wally Chin w/ URS
Interest Rate for Debt Service	6.25%	assume
Life Cycle, years	20	
Irrigation Period, months/yr	5	
Peak Day to Average Day PF	1.54	per September 10, 2002 Reuse Memo Table 1
Conveyance O&M, % of Const	0.50%	consistent with Year 2000 reuse evaluation
Special X-ing O&M, % of Const	0.50%	
Cost/kw-hr	$0.05	assume per Ron Kohler with KC
Annual Labor Hours/FTE	1,850	assume 1,850 hours/year for 1 FTE per Ron Kohler with KC
Labor cost, $/hr	$43	assume per Ron Kohler with KC
Year 2001 ENR	7,339	
Year 2002/Jan 2003 ENR	7,560	

Year 2002 Project Costs, Millions of Dollars

Reuse Project	Buildings Capital	Buildings Annual O&M	Pump Stations Capital	Pump Stations Annual O&M	Conveyance Capital	Conveyance Annual O&M	Special Crossings Capital	Special Crossings Annual O&M	Membrane Filtration Capital	Membrane Filtration Annual O&M	UV Disinfection Capital	UV Disinfection Annual O&M	Total Project Cost Capital	Total Project Cost Annual O&M
MBR Plant														
Wellington Hills	$1.03	$0.00	$1.02	$0.02	$0.53	$0.002	$0.46	$0.00			$0.15	$0.002	$3.19	$0.03
Northeast Initial	$1.50	$0.00	$4.38	$0.07	$8.09	$0.02	$1.96	$0.00			$0.59	$0.01	$16.53	$0.11
Northeast Future	$1.50	$0.00	$13.00	$0.48	$54.30	$0.16	$9.79	$0.02			$7.93	$0.10	$86.52	$0.76
South Alt 1	$1.03	$0.00	$4.51	$0.09	$17.13	$0.05	$6.39	$0.02			$2.53	$0.04	$31.59	$0.20
West Initial Alt 1	$1.50	$0.00	$8.91	$0.13	$24.02	$0.07	$0.87	$0.00			$0.82	$0.01	$36.11	$0.21
West Future Alt 1	$1.96	$0.00	$11.49	$0.20	$42.30	$0.12	$1.91	$0.00			$1.63	$0.02	$59.30	$0.35
South Alt 2	$1.03	$0.00	$4.74	$0.09	$14.22	$0.04	$6.39	$0.02			$2.53	$0.04	$28.90	$0.19
West Initial Alt 2	$3.00	$0.00	$7.33	$0.09	$8.15	$0.02	$0.87	$0.00			$0.82	$0.01	$20.16	$0.13
West Future Alt 2	$3.00	$0.00	$9.71	$0.18	$22.85	$0.07	$1.91	$0.00			$1.63	$0.02	$39.09	$0.28
CAS Plant														
Wellington Hills	$1.60	$0.00	$1.02	$0.02	$0.53	$0.002	$0.46	$0.00	$1.38	$0.02	$0.15	$0.002	$5.14	$0.05
Northeast Initial	$2.06	$0.00	$4.38	$0.07	$8.09	$0.024	$1.96	$0.00	$5.34	$0.05	$0.59	$0.01	$22.43	$0.16
Northeast Future	$10.99	$0.00	$13.00	$0.48	$54.30	$0.159	$9.79	$0.02	$42.41	$0.60	$7.93	$0.10	$138.41	$1.36
South Alt 1	$3.20	$0.00	$4.51	$0.09	$17.13	$0.048	$6.39	$0.02	$15.54	$0.17	$2.53	$0.04	$49.29	$0.37
West Initial Alt 1	$2.06	$0.00	$8.91	$0.13	$24.02	$0.068	$0.87	$0.00	$7.32	$0.07	$0.82	$0.01	$44.00	$0.28
West Future Alt 1	$2.53	$0.00	$11.49	$0.20	$42.30	$0.121	$1.91	$0.00	$11.50	$0.13	$1.63	$0.02	$71.36	$0.48
South Alt 2	$3.20	$0.00	$4.74	$0.09	$14.22	$0.04	$6.39	$0.02	$15.54	$0.17	$2.53	$0.04	$46.60	$0.36
West Initial Alt 2	$4.13	$0.00	$7.33	$0.09	$8.15	$0.02	$0.87	$0.00	$8.36	$0.05	$0.82	$0.01	$29.66	$0.18
West Future Alt 2	$4.13	$0.00	$9.71	$0.18	$22.85	$0.07	$1.91	$0.00	$12.13	$0.12	$1.63	$0.02	$52.36	$0.40

Year 2002, Millions of Dollars

Reuse Project	Annual Debt Service	Annual OM Cash Flow	Total Present Worth	CCF Produced /Year	Equiv Annual Cash Flow	Annual Unit Cost per CCF
MBR Plant						
Wellington Hills	($0.28)	($0.03)	($3.53)	92,418	($0.31)	($3.39)
Northeast Initial	($1.47)	($0.11)	($17.77)	356,470	($1.58)	($4.43)
Northeast Future	($7.70)	($0.76)	($95.11)	4,752,934	($8.46)	($1.78)
South Alt 1	($2.81)	($0.20)	($33.83)	1,320,260	($3.01)	($2.28)
West Initial Alt 1	($3.21)	($0.21)	($38.44)	488,496	($3.42)	($7.00)
West Future Alt 1	($5.28)	($0.35)	($63.23)	976,992	($5.63)	($5.76)
South Alt 2	($2.57)	($0.19)	($31.08)	1,320,260	($2.76)	($2.09)
West Initial Alt 2	($1.79)	($0.13)	($21.59)	488,496	($1.92)	($3.93)
West Future Alt 2	($3.48)	($0.28)	($42.20)	976,992	($3.75)	($3.84)
CAS Plant						
Wellington Hills	($0.46)	($0.05)	($5.73)	92,418	($0.51)	($5.52)
Northeast Initial	($2.00)	($0.16)	($24.22)	356,470	($2.15)	($6.04)
Northeast Future	($12.31)	($1.36)	($153.71)	4,752,934	($13.67)	($2.88)
South Alt 1	($4.39)	($0.37)	($53.41)	1,320,260	($4.75)	($3.60)
West Initial Alt 1	($3.91)	($0.28)	($47.10)	488,496	($4.19)	($8.58)
West Future Alt 1	($6.35)	($0.48)	($76.74)	976,992	($6.83)	($6.99)
South Alt 2	($4.15)	($0.36)	($50.66)	1,320,260	($4.51)	($3.41)
West Initial Alt 2	($2.64)	($0.18)	($31.69)	488,496	($2.82)	($5.77)
West Future Alt 2	($4.66)	($0.40)	($56.83)	976,992	($5.06)	($5.17)

B R O W N A N D C A L D W E L L

BUILDING CAPITAL COST

Per Gene Johnson with BC

Building Const Cost (power, lighting), $/ft^2 165

			Year 2002 Base Bldg Const.	Contingency	Sales Tax	Allied Costs	Contractor OH & Profit	Year 2002 Construction Cost	Year 2002 Bldg Project
PS only									
< 5 mgd Building Area	1,400	sq ft	$231,000	$57,750	$25,699	$110,057	$41,580	$272,580	$466,086
5 to 10 mgd Building Area	1,400	sq ft	$231,000	$57,750	$25,699	$110,057	$41,580	$272,580	$466,086
36 mgd Building Area	2,000	sq ft	$330,000	$82,500	$36,713	$157,224	$59,400	$389,400	$665,837
With PS and UV									
< 5 mgd Building Area	3,100	sq ft	$511,500	$127,875	$56,904	$243,698	$92,070	$603,570	$1,032,047
5 to 10 mgd Building Area	3,100	sq ft	$511,500	$127,875	$56,904	$243,698	$92,070	$603,570	$1,032,047
36 mgd Building Area	4,500	sq ft	$742,500	$185,625	$82,603	$353,755	$133,650	$876,150	$1,498,133

11-Feb-03	Bill Persich		TCG	1/312003			
Date Checked	Checked By		By	Date	Calc. No.		Sheet
Brightwater		**Reuse Water Building Cost Estimate**					
Project		Subject					

PUMPING STATIONS CAPITAL AND O&M COST

Tabula Contractor OH & P 18%

Tabula Flow	Low Head <300' TDH [1]Year 2002 Construction Cost	High Head >300' TDH [1]Year 2002 Construction Cost	High Head >300' TDH [2]Adjusted Const Cost	Contingency	Sales Tax	Allied Costs	Contractor OH & Profit	High Head >300' TDH Year 2002 PS Project Capital Costs	Low Head <300' TDH [2]Adjusted Const Cost	Contingency	Sales Tax	Allied Costs	Contractor OH & Profit	Low Head <300' TDH Year 2002 PS Project Capital Costs
	80%								80%					
0.5	$542,373	$754,237	$603,390	$150,847	$67,127	$287,478	$108,610	$1,217,452	$433,898	$108,475	$48,271	$206,725	$78,102	$875,471
0.7	$630,508	$879,661	$703,729	$175,932	$78,290	$335,283	$126,671	$1,419,905	$504,407	$126,102	$56,115	$240,318	$90,793	$1,017,735
0.9	$718,644	$1,005,085	$804,068	$201,017	$89,453	$383,088	$144,732	$1,622,358	$574,915	$143,729	$63,959	$273,911	$103,485	$1,159,999
1.4	$938,983	$1,318,644	$1,054,915	$263,729	$117,359	$502,601	$189,885	$2,128,489	$751,186	$187,797	$83,569	$357,893	$135,214	$1,515,659
2.0	$1,203,390	$1,694,915	$1,355,932	$338,983	$150,847	$646,017	$244,068	$2,735,847	$962,712	$240,678	$107,102	$458,672	$173,288	$1,942,452
2.7	$1,511,864	$2,133,898	$1,707,119	$426,780	$189,917	$813,335	$307,281	$3,444,432	$1,209,492	$302,373	$134,556	$576,247	$217,708	$2,440,376
2.8	$1,555,932	$2,196,610	$1,757,288	$439,322	$195,498	$837,238	$316,312	$3,545,658	$1,244,746	$311,186	$138,478	$593,044	$224,054	$2,511,508
3.7	$1,952,542	$2,761,017	$2,208,814	$552,203	$245,731	$1,052,362	$397,586	$4,456,696	$1,562,034	$390,508	$173,776	$744,212	$281,166	$3,151,696
5.1	$2,033,898	$2,923,729	$2,338,983	$584,746	$260,212	$1,114,379	$421,017	$4,719,337	$1,627,119	$406,780	$181,017	$775,220	$292,881	$3,283,017
6.5	$2,245,763	$3,241,525	$2,593,220	$648,305	$288,496	$1,235,507	$466,780	$5,232,308	$1,796,610	$449,153	$199,873	$855,972	$323,390	$3,624,998
7.4	$2,457,627	$3,559,322	$2,847,458	$711,864	$316,780	$1,356,636	$512,542	$5,745,280	$1,966,102	$491,525	$218,729	$936,725	$353,898	$3,966,979
10.0	$2,796,610	$4,152,542	$3,322,034	$830,508	$369,576	$1,582,742	$597,966	$6,702,826	$2,237,288	$559,322	$248,898	$1,065,928	$402,712	$4,514,148
27.0	$4,576,271	$6,864,407	$5,491,525	$1,372,881	$610,932	$2,616,369	$988,475	$11,080,182	$3,661,017	$915,254	$407,288	$1,744,246	$658,983	$7,386,788
36	$5,338,983	$8,050,847	$6,440,678	$1,610,169	$716,525	$3,068,581	$1,159,322	$12,995,275	$4,271,186	$1,067,797	$475,169	$2,034,953	$768,814	$8,617,919

[1]Tabula Assumptions
Construction Year: 2002
Excavation Depth: 0 ft
The estimated construction cost excludes contractor overhead and profit markups.
High Head = 350' TDH, Low Head = 250' TDH

[2]Tabula was developed for wastewater pumping stations. Since water pumping machinery is less expensive than wastewater, and electrical classification for water pump stations is not as extensive as for wastewater, it was assumed that water pump stations would cost approximately 10% less than wastewater pump stations. Furthermore, a 10% reduction was applied to remove building costs

	Input	Comment
Overall Pump Efficiency	75%	assume
PS Maint Cost, % of Const	0.50%	consistent with Year 2000 Reuse evaluation
Annual Pump Usage	42%	assume irrigation season from May through September (5/12 months)

Pumping Station	[1]TDH (ft)	Peak Day Flow (mgd)	Capital Costs: Year 2002 Const. Capital Cost	Year 2002 Project Capital Cost	Year 2002 Total Project Capital Cost	O&M Costs: Annual Pump Station Maintenance Cost	Annual Power Reqts (kw-hr)	Actual Annual Power Reqts (kw-hr)	Annual Pump Power Cost	Labor FTE's Reqd	Actual Annual Labor Hours	Annual Labor Cost	Annual PS OM Cost	Total Annual PS OM Cost
Northeast Initial		**2.7**			$4,382,828									$73,944
Route 9 PS 1 NEI	200	2.7	$1,209,492	$2,440,376		$6,047	$825,492	$343,955	$17,198	0.50	385	$16,573	$39,818	
Route 9 PS 2 NEI	200	2.0	$962,712	$1,942,452		$4,814	$611,476	$254,782	$12,739	0.50	385	$16,573	$34,126	
Wellington Hills					$1,017,735									$21,324
Route 9 PS Wellington Hills	100	**0.7**	$504,407	$1,017,735		$2,522	$107,008	$44,587	$2,229	0.50	385	$16,573	$21,324	
Northeast Future		**36.0**			$12,995,275									$476,846
Route 9 PS NEF	330	36.0	$6,440,678	$12,995,275		$32,203	$18,160,828	$7,567,012	$378,351	2.0	1,542	$66,292	$476,846	
South Alt 1					$4,514,148									$92,104
Route 9 PS South	150	10.0	$2,237,288	$4,514,148		$11,186	$2,293,034	$955,431	$47,772	1.00	771	$33,146	$92,104	
West Initial Alt 1		**3.7**			$8,913,391									$125,936
Route 9 PS WI	300	3.7	$2,208,814	$4,456,696		$11,044	$1,696,845	$707,019	$35,351	0.50	385	$16,573	$62,968	
Booster WI	300	3.7	$2,208,814	$4,456,696		$11,044	$1,696,845	$707,019	$35,351	0.50	385	$16,573	$62,968	
West Future Alt 1		**7.4**			$11,490,559									$203,024
Route 9 PS WF	300	7.4	$2,847,458	$5,745,280		$14,237	$3,393,690	$1,414,038	$70,702	0.50	385	$16,573	$101,512	
Booster WF	300	7.4	$2,847,458	$5,745,280		$14,237	$3,393,690	$1,414,038	$70,702	0.50	385	$16,573	$101,512	
Alternative 2														
Contingency for coordinating pump station installation in portal		5%												
	TDH													
West Initial Alt 2		**3.7**			$7,332,071									$90,165
Portal 19 PS 1 WI	220	0.9	$603,661	$1,217,999		$3,018	$302,680	$126,117	$6,306	0.20	154	$6,629	$15,953	
Portal 19 PS 2 WI	220	0.5	$433,898	$875,471		$2,169	$168,156	$70,065	$3,503	0.20	154	$6,629	$12,302	
Portal 5 PS 1 WI	300	2.8	$1,845,153	$3,722,941		$9,226	$1,284,099	$535,041	$26,752	0.20	154	$6,629	$42,607	
Portal 5 PS 2 WI	200	1.4	$751,186	$1,515,659		$3,756	$428,033	$178,347	$8,917	0.20	154	$6,629	$19,302	
West Future Alt 2		**7.4**			$9,705,966									$183,770
Portal 19 PS 1 WF	220	0.9	$603,661	$1,217,999		$3,018	$302,680	$126,117	$6,306	0.20	154	$6,629	$15,953	
Portal 19 PS 2 WF	220	0.5	$433,898	$875,471		$2,169	$168,156	$70,065	$3,503	0.20	154	$6,629	$12,302	
Portal 5 PS 1 WF	250	6.5	$1,886,441	$3,806,248		$9,432	$2,484,120	$1,035,050	$51,752	0.50	385	$16,573	$77,758	
Portal 5 PS 2 WF	250	6.5	$1,886,441	$3,806,248		$9,432	$2,484,120	$1,035,050	$51,752	0.50	385	$16,573	$77,758	
Portion of West Initial Alt 2														
Portal 5 PS 1 WI	300	1.4	$1,107,661	$2,234,914		$5,538	$642,049	$267,521	$13,376	0.20	154	$6,629	$25,544	
Reuse at BW Site	50	1	$603,661	$1,217,999		$3,018	$68,791	$28,663	$1,433	0.20	154	$6,629	$11,081	
South Alt 2					$4,739,856									$92,663
Portal 41 PS South	150	10.0	$2,349,153	$4,739,856		$11,746	$2,293,034	$955,431	$47,772	1.00	771	$33,146	$92,663	

CONVEYANCE CAPITAL COST

OPEN CUT

Tabula Contractor OH & P 18%

Diameter, in	[1]Year 2002 Base Const Cost/ft	100% Adjusted Const Cost/ft	Contingency/ft	Sales Tax/ft	Allied Costs/ft	Contractor OH & Profit/ft	Year 2002 Const Cost/ft	Conveyance Project Costs/ft
8	$131	$131	$33	$15	$62	$23	$154	$263
10	$139	$139	$35	$15	$66	$25	$164	$280
12	$149	$149	$37	$17	$71	$27	$176	$301
14	$170	$170	$43	$19	$81	$31	$201	$344
16	$181	$181	$45	$20	$86	$32	$213	$364
18	$192	$192	$48	$21	$92	$35	$227	$388
20	$210	$210	$53	$23	$100	$38	$248	$424
24	$236	$236	$59	$26	$112	$42	$278	$475
30	$292	$292	$73	$33	$139	$53	$345	$590
36	$356	$356	$89	$40	$170	$64	$420	$718
42	$406	$406	$101	$45	$193	$73	$479	$819
48	$508	$508	$127	$56	$242	$91	$599	$1,024

[1]Tabula Assumptions

Construction Year: 2002
Conduit Type: Force Main
Depth of Cover: 6 ft
Trench Backfill Type: Imported
Existing Utilities: Average
Dewatering: Minimal
Pavement Restoration: Trench Width
Traffic: Light
Land Acquisition: None
Required Easements: None
Trench Safety: Standard
The estimated construction cost excludes contractor overhead and profit markups.

Conveyance Pipe	Length, ft	Diameter, in	Year 2002 Project Cost	Year 2002 Const. Cost	Surface Project	Surface Const	
Northeast Initial Trunk 1	15,600	12	$4,694,714	$2,745,600			
Northeast Initial Trunk 2	7,000	8	$1,843,277	$1,078,000			
Wellington Golf Course	1,200	8	$315,990	$184,800			
Flower World	1,900	8	$500,318	$292,600			
Echo Falls Country Club	2,800	8	$737,311	$431,200			
Northeast Initial			**$8,091,611**	**$4,732,200**			
Wellington Hills	2,000	8	**$526,651**	**$308,000**			
Northeast Future Trunk 1	15,600	48	$15,978,033	$9,344,400			
Northeast Future Trunk 2	7,000	48	$7,169,630	$4,193,000			
Wellington Golf Course	1,200	8	$315,990	$184,800			
Flower World	1,900	8	$500,318	$292,600			
Echo Falls Country Club	2,800	8	$737,311	$431,200			
Ag & Bob Heirman WL Park	28,900	48	$29,600,331	$17,311,100			
Northeast Future			**$54,301,613**	**$31,757,100**			
South Alt 1	24,100	30	**$14,217,002**	**$8,314,500**			
South Alt 2	24,100	30	**$14,217,002**	**$8,314,500**			
Portal 5 East Trunk	11,200	10	$3,140,753	$1,836,800			
Highlands, Inc.	350	8	$92,164	$53,900			
Abbey View Cemetery	2,800	8	$737,311	$431,200			
Surface from 44 to Highland WI	11,000	16	$4,006,307	$2,343,000			
Surface from Highland to 5 WI	10,000	14	$3,436,908	$2,010,000			
Surface from 5 to 19 WI	20,000	8	$5,266,506	$3,080,000	$12,709,721		
Portal 5 West Trunk WI	2,700	10	$757,146	$442,800			
Ballinger Park Golf Course	1,300	8	$342,323	$200,200			
Nile Temple Golf Course	1,700	10	$476,721	$278,800			
Holyrood Cemetery	200	8	$52,665	$30,800	$1,628,855	$952,600	**Portion of West Alt 2**
Portal 19 Trunk	2,700	8	$710,978	$415,800			
Edmonds Memorial Cemetery	3,900	8	$1,026,969	$600,600			
Restlawn Memorial Gardens	1,700	8	$447,653	$261,800			
Standard Oil of California	1,400	8	$368,655	$215,600			
West Initial Alt 1			**$20,863,060**	**$12,201,300**			
West Initial Alt 2			**$8,153,338**	**$4,768,300**			
Portal 5 West Trunk WF	2,700	18	$1,048,001	$612,900			
Portal 5 South Trunk	16,000	14	$5,499,053	$3,216,000			
Jackson Park Golf Course	2,700	8	$710,978	$415,800			
Seattle Golf & Country Club	5,300	12	$1,594,999	$932,800			
Surface from 44 to Highland WF	11,000	24	$5,228,888	$3,058,000		305	$3,355,000
Surface from Highland to 5 WF	10,000	20	$4,240,564	$2,480,000		255	$2,550,000
Surface from 5 to 19 WF	20,000	8	$5,266,506	$3,080,000	$14,735,958	105	$2,100,000
							$8,005,000
Portal 5 North Trunk	10,800	10	$3,028,583	$1,771,200			
Yost Memorial Park	6,900	8	$1,816,945	$1,062,600			
Edmonds Community College	1,400	8	$368,655	$215,600			
Lynnwood Municipal Golf	2,400	8	$631,981	$369,600			
West Initial Alt 1			$8,153,338	$4,768,300			
West Future Alt 1			**$37,588,492**	**$21,982,800**			
West Future Alt 2			**$22,852,534**	**$13,364,800**			
Portal 5 West Trunk WI	2,700	10	$757,146	$442,800			
Ballinger Park Golf Course	1,300	8	$342,323	$200,200			
Nile Temple Golf Course	1,700	10	$476,721	$278,800			
Holyrood Cemetery	200	8	$52,665	$30,800			
Portion of West Initial Alt 2			**$1,628,855**	**$952,600**			

COMBINED TUNNEL REUSE PIPE

Tabula Contractor OH & P 18%

Diameter, in	[1]Year 2002 Base Const Cost/ft	[2]Contingency/ft	Sales Tax/ft	Allied Costs/ft	Contractor OH & Profit/ft	Year 2002 Const Cost/ft	Year 2002 Conveyance Project Costs/ft	
8		$0	$0	$0	$0	$0	$0	
10		$0	$0	$0	$0	$0	$0	
12		$0	$0	$0	$0	$0	$0	
14		$0	$0	$0	$0	$0	$0	
16	$57	$20	$7	$29	$10	$67	$123	
20		$0	$0	$0	$0	$0	$0	
24	$85	$30	$10	$44	$15	$100	$183	$2,384,842
30	$106	$37	$13	$55	$19	$125	$229	
36	$127	$44	$15	$65	$23	$150	$275	$3,494,710
								$6,173,529.74

[1]Per April 9, 2003 memo from Don Davis with URS to Edith Hadler with HDR

[2]The contingency for the combined tunnel reuse pipe is 35% to account for special pipe testing methods in the tunnel and to negotiate bringing the pipe through the tunnel to the surface.

CONVEYANCE SUMMARY

			COMBINED TUNNEL REUSE PIPE		OPEN CUT		Total	
Conveyance Pipe	Length, ft	Diameter, in	Year 2002 Project Cost	Year 2002 Const. Cost	Year 2002 Project Cost	Year 2002 Const Cost	Year 2002 Project Cost	Year 2002 Const Cost
Combined Tunnel Reuse Pipe to 41 WI	12,700	16	$1,560,971	$721,102				
Combined Tunnel Reuse Pipe to 44 WI	13,000	16	$1,597,844	$738,136				
West Initial Alt 1	25,700		**$3,158,815**	**$1,459,237**	**$20,863,060**	**$12,201,300**	**$24,021,874**	**$13,660,537**
Combined Tunnel Reuse Pipe to 41 WF	12,700	24	$2,329,807	$1,076,271				
Combined Tunnel Reuse Pipe to 44 WF	13,000	24	$2,384,842	$1,101,695				
West Future Alt 1			**$4,714,649**	**$2,177,966**	**$37,588,492**	**$21,982,800**	**$42,303,141**	**$24,160,766**
Combined Tunnel Reuse Pipe to 41 South	12,700	30	$2,912,259	$1,345,339				
South Alt 1			**$2,912,259**	**$1,345,339**	**$14,217,002**	**$8,314,500**	**$17,129,261**	**$9,659,839**
Wellington Hills					**$526,651**	**$308,000**	**$526,651**	**$308,000**
Northeast Initial					**$8,091,611**	**$4,732,200**	**$8,091,611**	**$4,732,200**
Northeast Future					**$54,301,613**	**$31,757,100**	**$54,301,613**	**$31,757,100**
Alternative 2								
South Alt 2					**$14,217,002**	**$8,314,500**	**$14,217,002**	**$8,314,500**
West Initial Alt 2					**$8,153,338**	**$4,768,300**	**$8,153,338**	**$4,768,300**
West Future Alt 2					**$22,852,534**	**$13,364,800**	**$22,852,534**	**$13,364,800**
Portion of West Initial Alt 2								
Northeast Initial (excluding WHills)					$7,775,620	$4,547,400	$7,775,620	$4,547,400

			TCG	April 28, 2003		
Date Checked	Checked By		By	Date	Calc. No.	Sheet
Brightwater		**Water Reuse Conveyance Cost Estimate**				
Project		Subject				

SPECIAL CROSSINGS (MICROTUNNEL)

Tabula Contractor OH & P 18%

Diameter, in	[1]Year 2002 Construction	Contingency/ft	Sales Tax/ft	Allied Costs/ft	Contractor OH & Profit/ft	Special Crossings Project Costs	
12	$572	$143	$64	$273	$103	$1,154	
16	$640	$160	$71	$305	$115	$1,291	
30	$1,021	$255	$114	$487	$184	$2,060	$2.0177
48	$1,441	$360	$160	$686	$259	$2,907	

[1]Tabula Assumptions
Construction Year: 2002
Dewatering: Minimal
Launch Shaft Existing Utilities: Average
Launch Shaft Excavation Depth: 15 ft
Launch Shaft Surface Restoration: Hydroseed
Retrieval Shaft Excavation Depth: 15 ft
Retrieval Shaft Surface Restoration: Hydroseed
Retrieval Shaft Existing Utilities: Average
Tunnel Easement Length: 0 ft
Easement Type: None
Traffic: Light
Casing Required: false
Number of Intermediate Shafts: 0
Intermediate Shaft Existing Utilities: Average
Intermediate Shaft Excavation Depth: 15 ft
Intermediate Shaft Surface Restoration: Hydroseed
The estimated construction cost includes only contractor overhead and profit markups.

Crossing	Pipe	Type	**Reuse Option**	Length (ft)	Diameter (in)	MT Diameter (in)	Year 2002 Project Cost	Total Project	Year 2002 Const Cost	Total Const.
West Nearby 205th	Nile Temple Golf Course	Major Street	West Initial Alt 1	300	10	12	$346,256	$865,639	$171,610	$429,025
West Nearby Stream	Nile Temple Golf Course	Stream	West Initial	450	10	12	$519,384		$257,415	
			West Initial Alt 2					$865,639		$429,025
West Outer SR 99	Portal 5 North Trunk	Major Arterial	West Future Alt 1	400	10	12	$461,674	$1,908,254	$228,814	$945,763
West Outer Stream	Portal 5 South Trunk	Stream	West Future Alt 1	450	14	16	$580,940		$287,924	
			West Future Alt 2					$1,908,254		$945,763
South SR 522	South Alt 1	Freeway	South Alt 1	400	30	30	$824,174	$6,387,349	$408,475	$3,165,678
South Samm River	South Alt 1	Stream	South Alt 1	450	30	30	$927,196		$459,534	
South Stream 2	South Alt 1	Stream	South Alt 1	450	30	30	$927,196		$459,534	
South Stream 3	South Alt 1	Stream	South Alt 1	450	30	30	$927,196		$459,534	
South Stream 4	South Alt 1	Stream	South Alt 1	450	30	30	$927,196		$459,534	
South Stream 5	South Alt 1	Stream	South Alt 1	450	30	30	$927,196		$459,534	
South Stream 6	South Alt 1	Stream	South Alt 1	450	30	30	$927,196		$459,534	
Northeast SR 522 (1)	Wellington Golf Course	Freeway	Wellington Hills	400	8	12	$461,674	$461,674	$228,814	$943,856
Northeast SR 522 (1)	Wellington Golf Course	Freeway	Northeast Initial	400	8	12	$461,674	$1,962,116	$228,814	$972,458
Northeast SR 522 (2)	Echo Falls Country Club	Freeway	Northeast Initial	400	8	12	$461,674		$228,814	
Northeast Stream 1	Northeast Initial Trunk 1	Stream	Northeast Initial	450	12	12	$519,384		$257,415	
Northeast Stream 2	Northeast Initial Trunk 2	Stream	Northeast Initial	450	8	12	$519,384		$257,415	
Northeast SR 522 (1)	Wellington Golf Course	Freeway	Northeast Future	400	8	12	$461,674	$9,789,204	$228,814	$4,851,695
Northeast SR 522 (2)	Echo Falls Country Club	Freeway	Northeast Future	400	8	12	$461,674		$228,814	
Northeast Stream 1	Northeast Future Trunk 1	Stream	Northeast Future	450	48	48	$1,308,077		$648,305	
Northeast Stream 2	Northeast Future Trunk 2	Stream	Northeast Future	450	48	48	$1,308,077		$648,305	
Northeast Stream 3	Ag & Bob Heirman WL Park	Stream	Northeast Future	450	48	48	$1,308,077		$648,305	
Northeast Stream 4	Ag & Bob Heirman WL Park	Stream	Northeast Future	450	48	48	$1,308,077		$648,305	
Northeast Stream 5	Ag & Bob Heirman WL Park	Stream	Northeast Future	1250	48	48	$3,633,547		$1,800,847	

BROWN AND CALDWELL

UV DISINFECTION COST

Per Dave Murray and Jeff Scarano with BC.

		20%								
Flow, mgd	$/mgd	E/I	Total UV Const./mgd	Contingency	Sales Tax	Allied Costs	Contractor OH & Profit	Year 2002 UV Project Capital $/mgd	O&M/mgd	Type
<7.4 mgd	$91,000	$18,200	**$109,200**	$27,300	$12,149	$52,027	$19,656	$220,331	$2,900	low pressure, high intensity
7.5 to 10 mgd	$104,400	$20,880	**$125,280**	$31,320	$13,937	$59,688	$22,550	$252,776	$4,333	medium pressure, high intensity
36 mgd	$78,000	$15,600	**$93,600**	$23,400	$10,413	$44,595	$16,848	$188,856	$4,333	medium pressure, high intensity

ATTACHMENT C

Reuse Water Summary Information for a CAS Plant

Schematic for Northeast and West Alternative 1 Projects

Schematic for South Projects and West Alternative 2 Projects

Total Project Capital and O&M Cost Tables

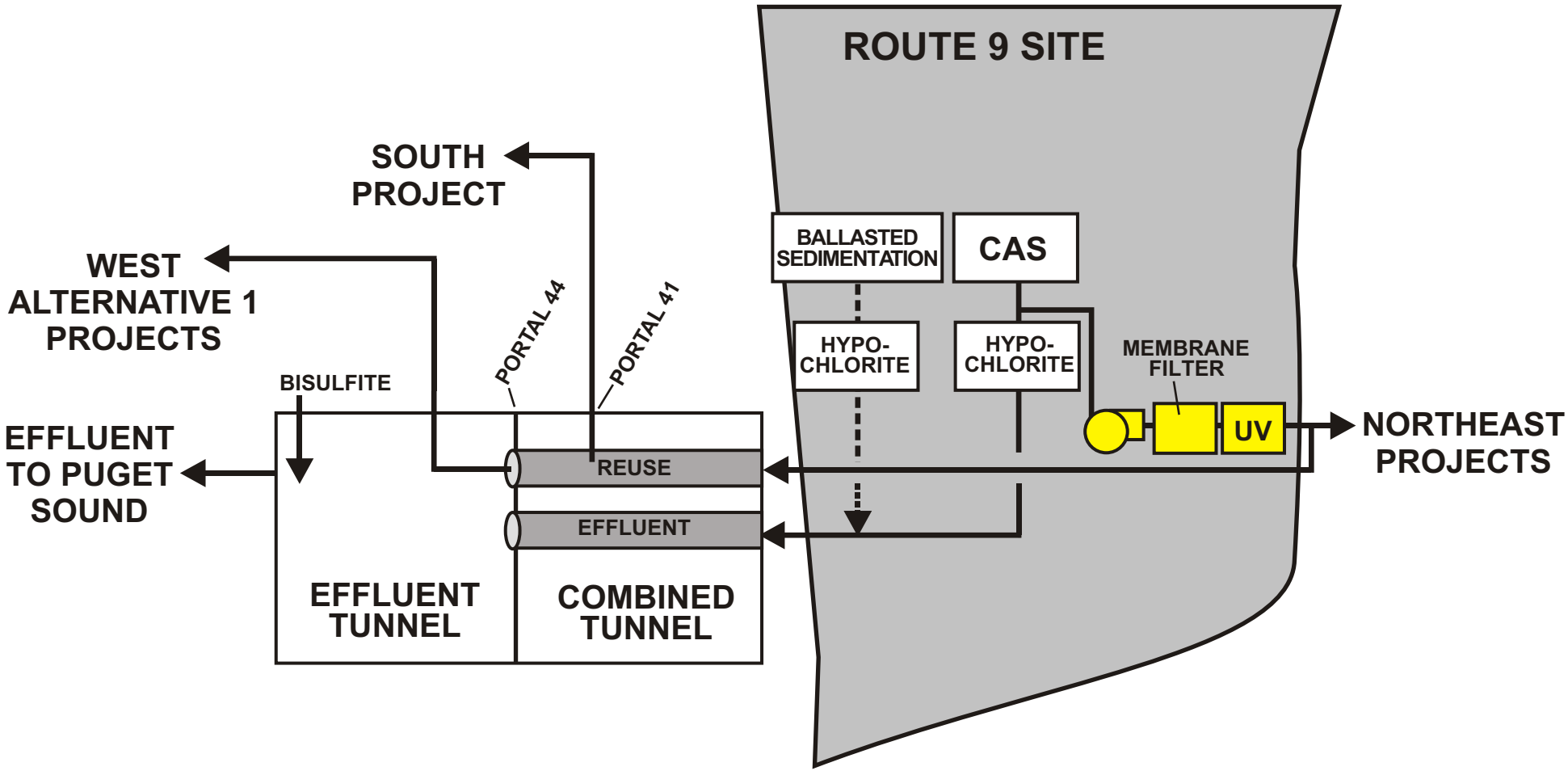
Total Project Capital Cost Figure

Annual O&M Cost Figure

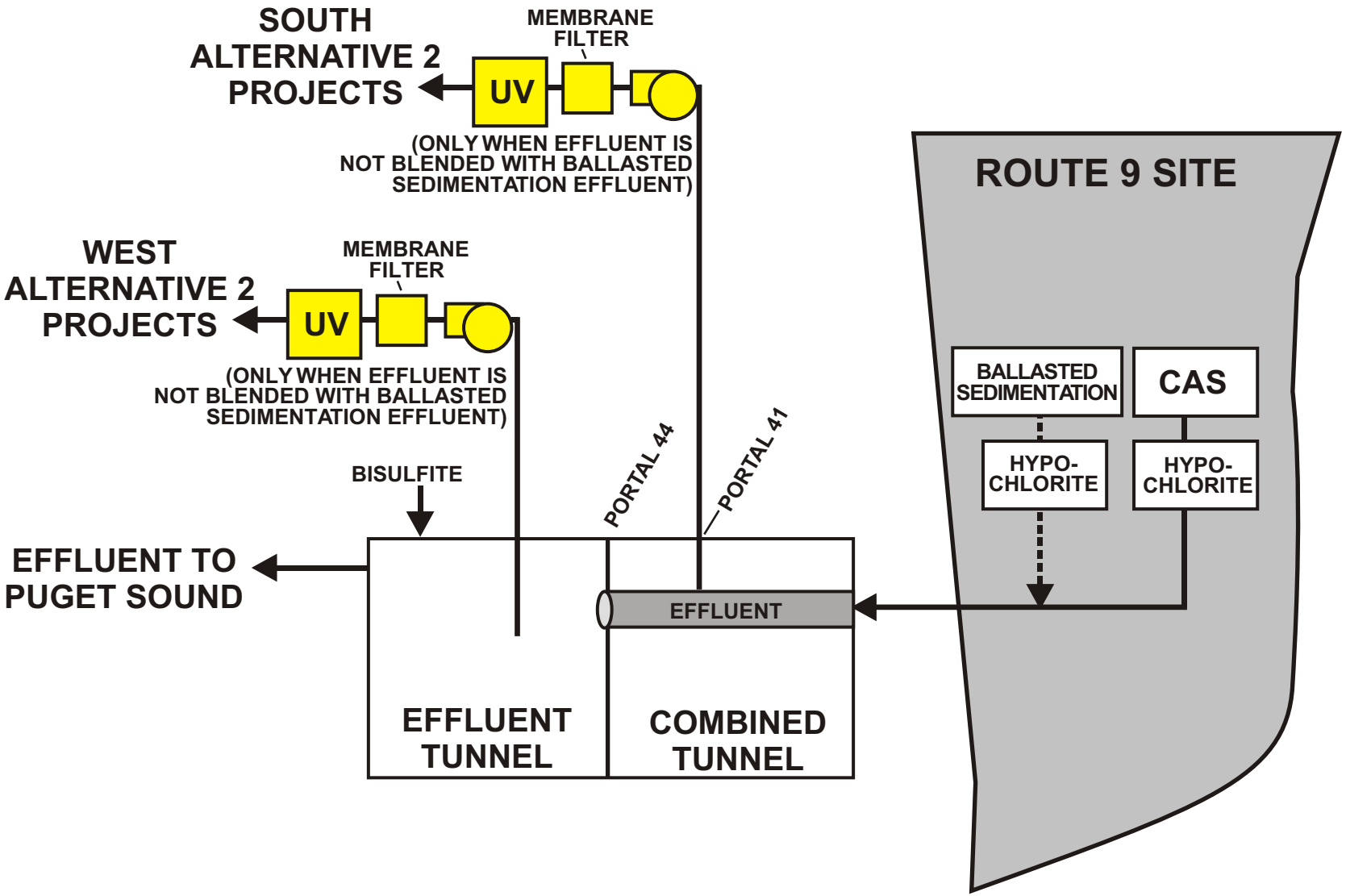
Total Annual Cost Figure

Levelized Cost Figure

NOTE: Information in Attachment C is included solely for general background information on the types of facilities needed for reuse water production assuming CAS treatment at the Brightwater plant. Since MBR treatment has been selected as the preferred treatment process, this information may not be current or valid.



Northeast, South Alternative 1 and West Alternative 1 (Dedicated Reuse Pipe) Schematic



South Alternative 2 and West Alternative 2 (Direct Tunnel Withdrawal) Schematic

PROJECT AND O&M COST SUMMARY TABLE (CAS PLANT)

	Year 2003 Total Project Capital Cost, Millions of Dollars[a, b]						Year 2003 Annual O&M Cost, Millions of Dollars[a,c]					Total Annnualized Cost, Millions of Dollars
Water Reuse Project	**B**	**PS**	**C**	**MF**	**UV**	**Total**	**PS[d]**	**C[e]**	**MF[f]**	**UV[f]**	**Total**	
Within Brightwater Facility	$1.60	$1.22	$0.20	$1.98	$0.22	$5.21	$0.02	$0.001	$0.02	$0.003	$0.05	$0.51
Wellington Hills	$1.60	$1.02	$0.99	$1.38	$0.15	$5.14	$0.02	$0.01	$0.02	$0.002	$0.05	$0.51
Northeast Initial	$2.06	$4.38	$10.05	$5.34	$0.59	$22.43	$0.07	$0.03	$0.05	$0.01	$0.16	$2.15
Northeast Future	$10.99	$13.00	$64.09	$42.41	$7.93	$138.41	$0.48	$0.18	$0.60	$0.10	$1.36	$13.67
South Initial[g]	$1.60	$0.79	$19.96	$2.33	$1.45	$26.13	$0.03	$0.03	$0.05	$0.01	$0.11	$2.44
South Future[g]	$3.20	$2.62	$26.80	$15.54	$4.72	$52.87	$0.11	$0.13	$0.17	$0.04	$0.45	$5.15
West Initial Alternative 1 –Dedicated Reuse Pipe	$2.06	$8.91	$24.89	$7.32	$0.82	$44.00	$0.13	$0.07	$0.07	$0.01	$0.28	$4.19
West Initial Alternative 2 –Direct Tunnel Withdrawal	$4.13	$7.33	$9.02	$8.36	$0.82	$29.66	$0.09	$0.03	$0.05	$0.01	$0.18	$2.82
West Future Alternative 1 – Dedicated Reuse Pipe	$2.53	$11.49	$44.21	$11.50	$1.63	$71.36	$0.20	$0.13	$0.13	$0.02	$0.48	$6.83
West Future Alternative 2 – Direct Tunnel Withdrawal	$4.13	$9.71	$24.76	$12.13	$1.63	$52.36	$0.18	$0.07	$0.12	$0.02	$0.40	$5.06

[a]B = buildings, PS = pump stations, C = conveyance (open cut water pipe, combined tunnel reuse water pipe, and special crossings), MF = membrane filtration, and UV = UV disinfection

[b]Total project costs include 18% for contractor overhead and profit, 25% for contingency, 8.9% for sales tax, and 35% for allied costs.

[c]Assumes water reuse application between months of May and September.

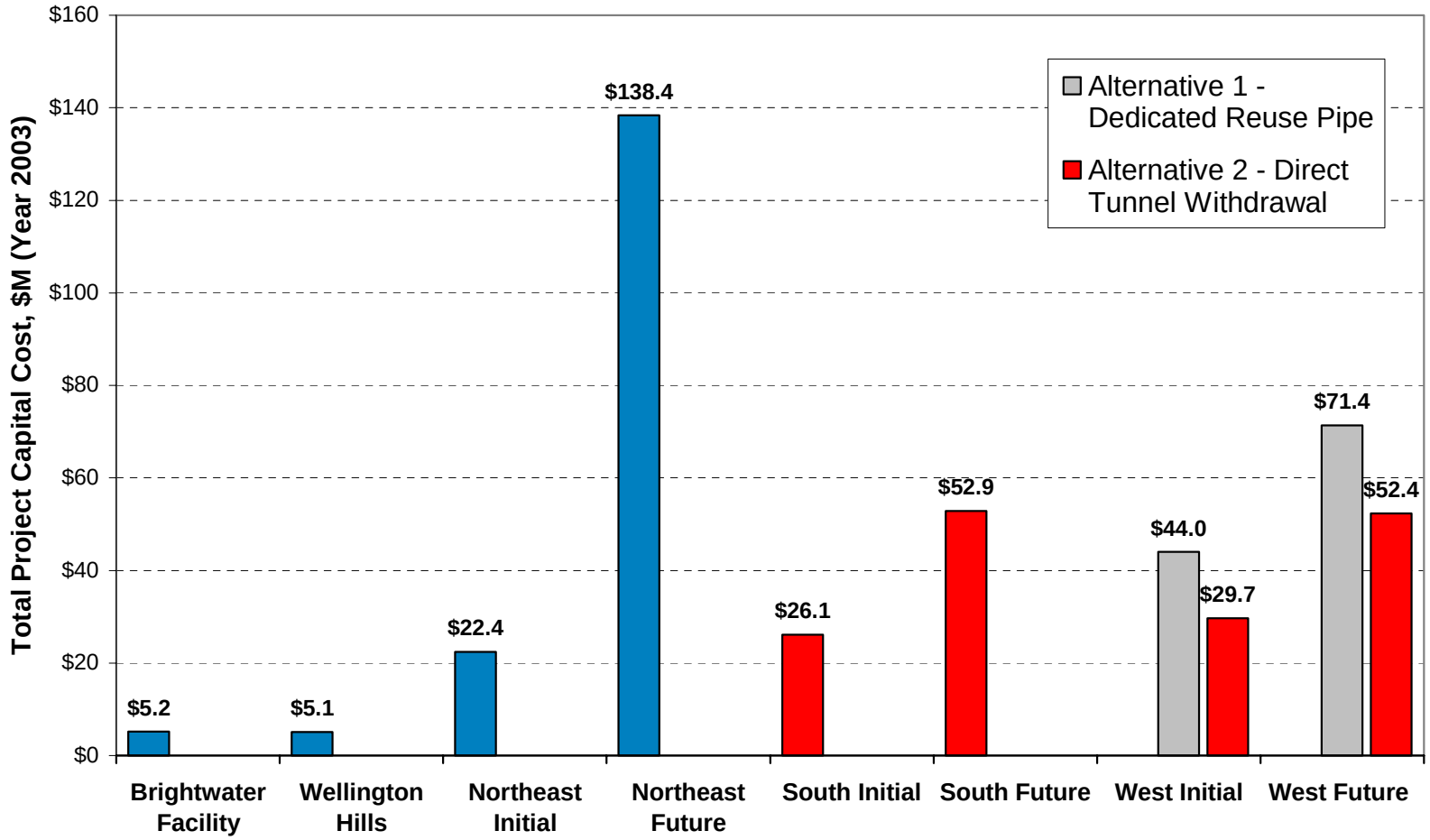
[d]Includes 0.5% of construction costs for annual O&M. Assumes $0.05/kw-hr and pump efficiency of 75%.

[e]Includes 0.5% of construction costs for annual O&M.

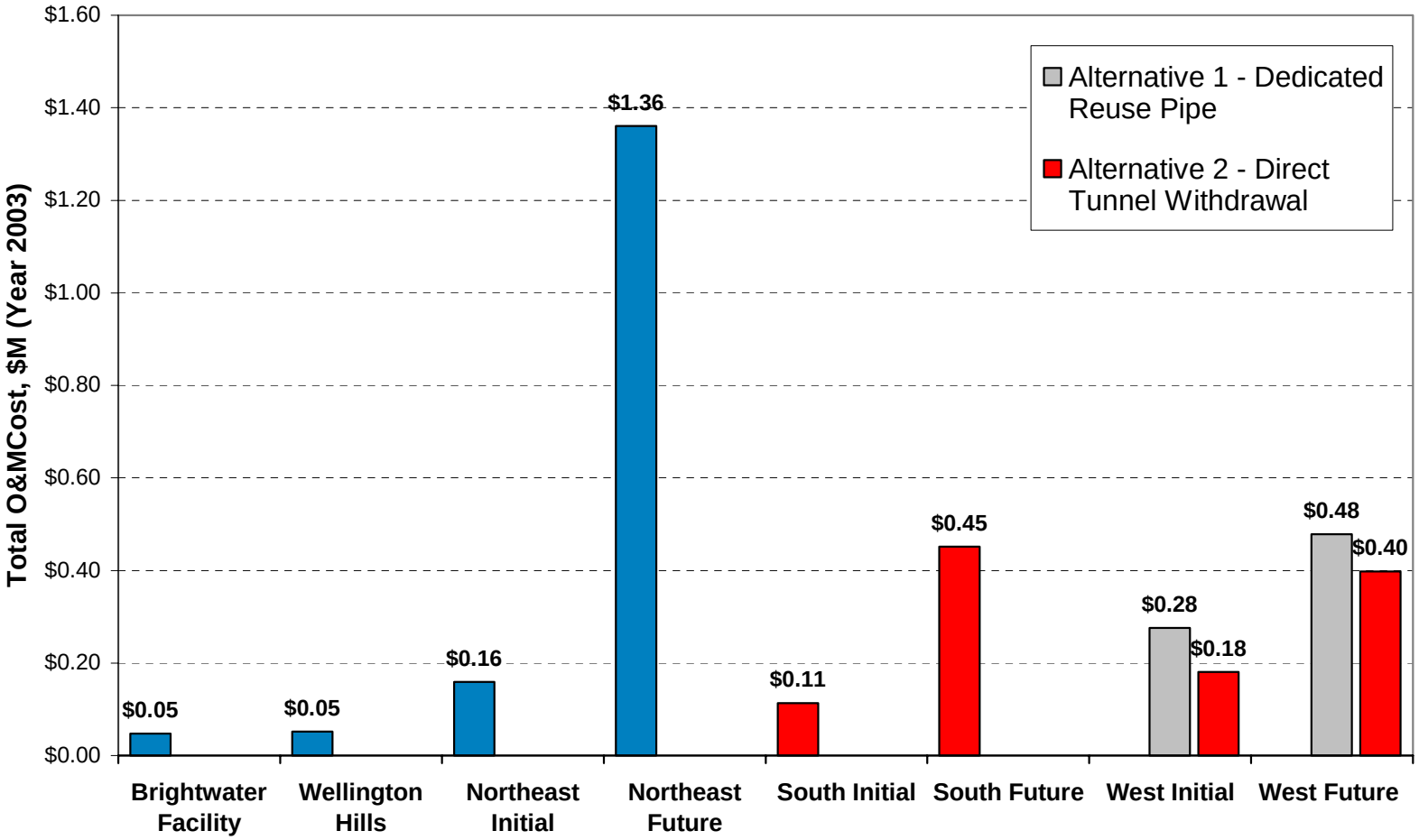
[f]Assumes $0.05/kw-hr.

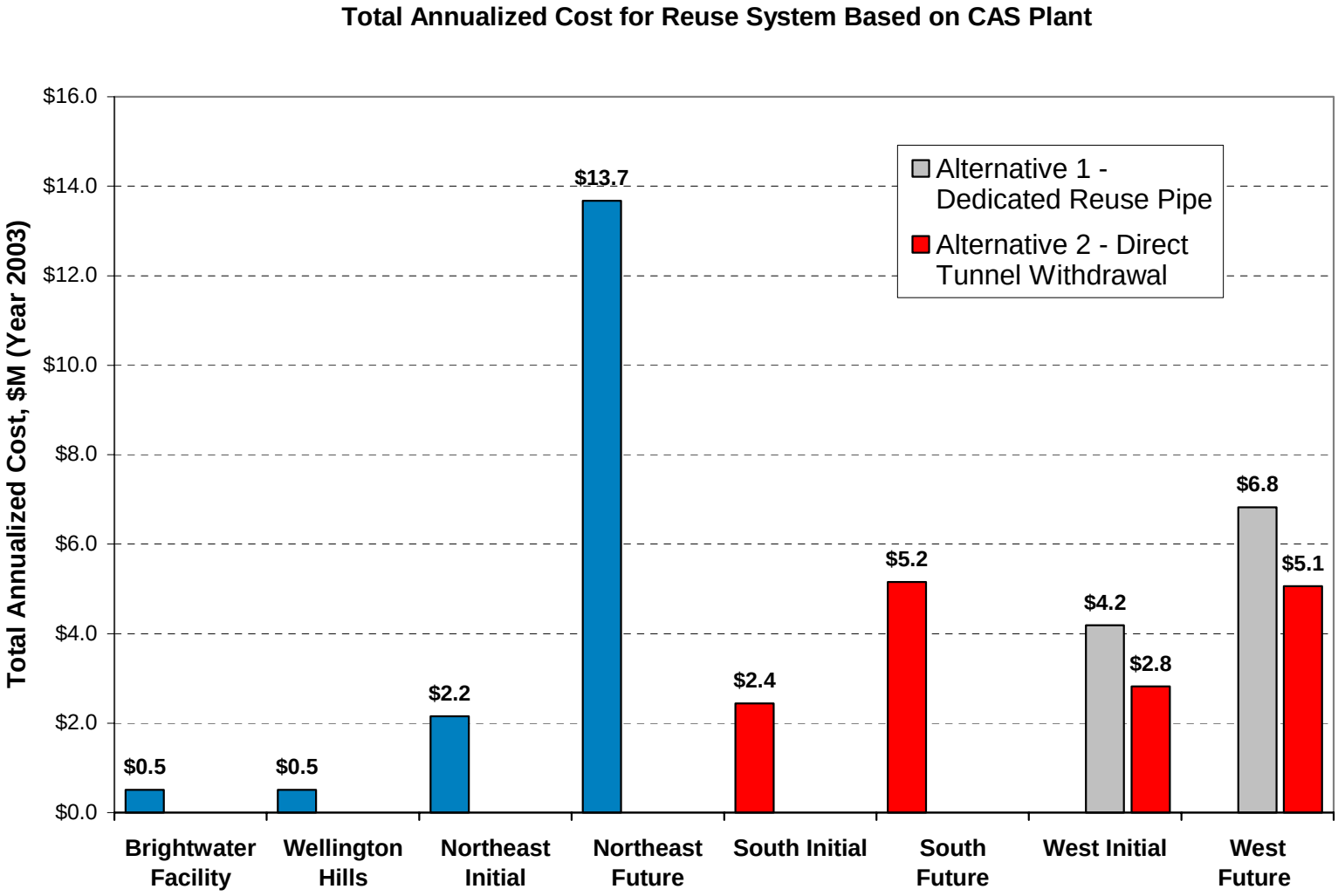
[g]Reference Brightwater – Sammamish TM in Attachment D. The Attachment D TM was based on the Brightwater plant being and MBR facility. The costs presented in this table do not correspond to the costs presented in the Attachment D TM.

Total Project Capital Cost for Reuse System Based on CAS Plant

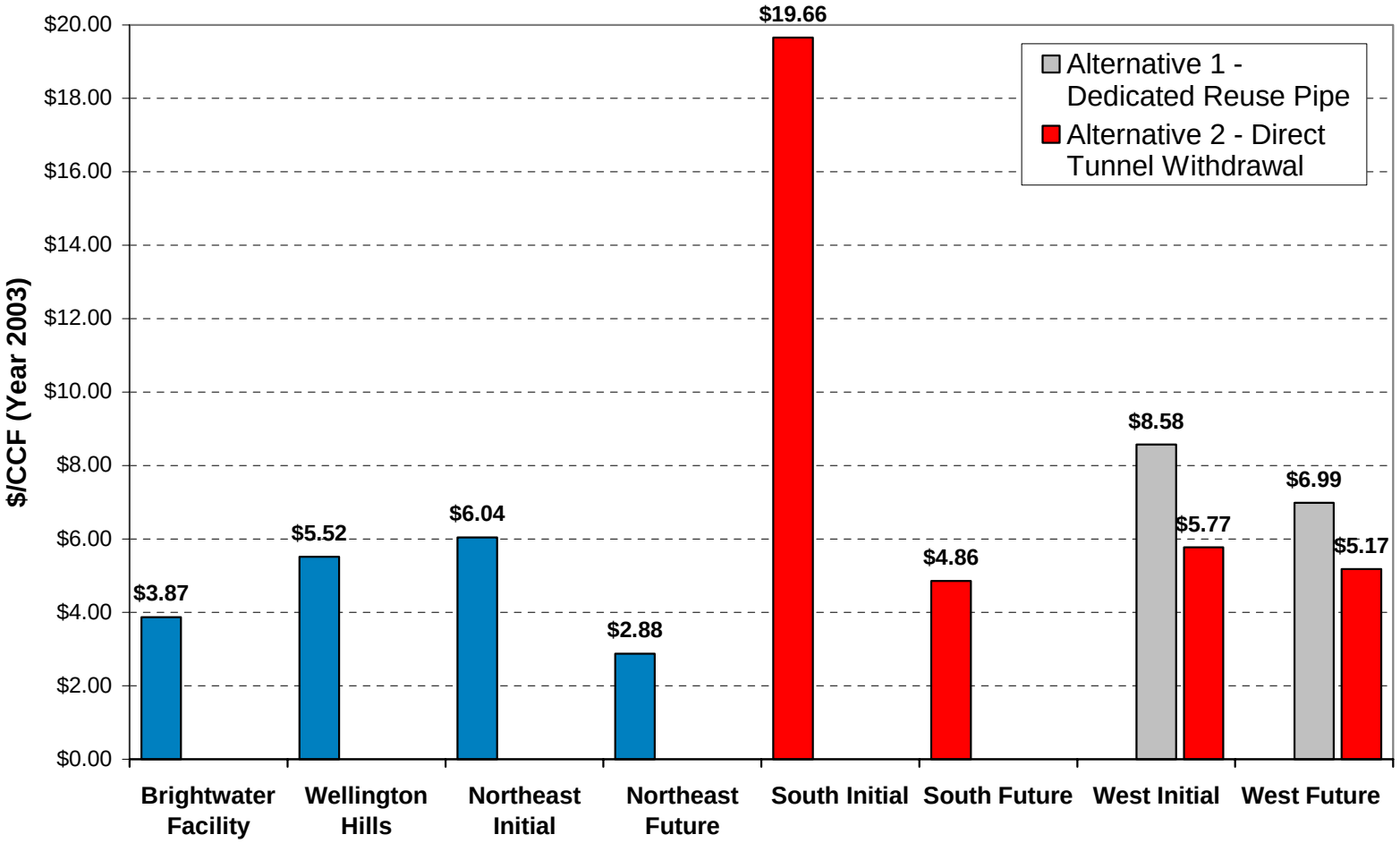


O&M Cost for Reuse System Based on CAS Plant




Total Annualized Cost for Reuse System Based on CAS Plant
Total Annualized Cost, $M (Year 2003)
$16.0
$14.0
$12.0
$10.0
$8.0
$6.0
$4.0
$2.0
$0.0
Alternative 1 - Dedicated Reuse Pipe
Alternative 2 - Direct Tunnel Withdrawal
$0.5
$0.5
$2.2
$13.7
$2.4
$5.2
$4.2
$2.8
$6.8
$5.1
Brightwater Facility
Wellington Hills
Northeast Initial
Northeast Future
South Initial
South Future
West Initial
West Future

Levelized Unit Cost for Reuse System Based on CAS Plant



ATTACHMENT D

Brightwater – Sammamish Project Conveyance Technical Memorandum (Based on York Alternative Site)

Technical MEMORANDUM

CH2M HILL
BROWN AND CALDWELL
and Associated Firms

Brightwater Treatment Plant

TO: Stan Hummel, King County

FROM: Bill Persich, Brown and Caldwell
Tadd Giesbrecht, Brown and Caldwell

CC: Tom Fox, King County
Steve Krugel, Brown and Caldwell
Dave Evans, CH2M Hill

DATE: August 22, 2003

SUBJECT: Brightwater Predesign Phase 2
Brightwater – Sammamish Project Conveyance
(Based on York Alternative Site)

Introduction

The purpose of this technical memorandum is to summarize a preliminary feasibility study of delivering reclaimed water from the proposed Route 9 Brightwater site to potential Sammamish Valley reuse customers. The two main objectives of this technical memorandum are as follows:

1) Develop a conveyance system from the proposed Brightwater facility to serve potential Sammamish Valley reclaimed water customers included as part of a previous Carollo Engineers evaluation described in Technical Memorandum No. 11 *Conveyance System Analysis* (TM 11) dated December 2002. A cost estimate of the Brightwater reclaimed water system will be compared to the cost estimate developed by Carollo Engineers as part of the draft *York Alternative Site and Configuration Evaluation* (York Evaluation) dated May 2003. Consistent with the York Evaluation cost estimate, the comparative Brightwater reclaimed water system will only be developed for initial potential reclaimed water customers. However, one initial phase option will develop the conveyance system to accommodate potential future reuse customers.

2) Develop a conveyance system from the proposed Brightwater facility to serve potential future Sammamish Valley reclaimed water customers.

Background

TM 11 was referenced to determine potential reclaimed water customers and their demands. Table 1 summarizes information from Table 11.2 of TM 11 and additional information used in this feasibility study.

Table 1. Sammamish Valley Reclaimed Water Demands[f]

Identified Customer	Average Day Demand[a,b] (mgd)	Peak Day Demand[c] (mgd)	Peak Hour Demand[d] (mgd)
Initial Phase			
Willows Run Golf Course	0.32	0.50 - 0.65	0.48 - 0.65
Farm LLC	0.13	0.20 - 0.25	0.40 - 0.49
60 Acres Soccer Field	0.13	0.20 - 0.25	0.48 - 0.59
Molbak's Greenhouse	0.03	0.04 - 0.05	0.12 - 0.14
Subtotal[h]	**0.61**	**0.94 - 1.20**	**1.47 - 1.87**
Second Phase			
Hmong Farm	0.20	0.31 - 0.38	0.32 - 0.37
JB Lawns	1.07	1.65 - 2.05	1.66 - 2.04[e]
Chateau Ste. Michelle Winery	0.34	0.53 - 0.66	1.58 - 1.99
Gold Creek Parks	0.11	0.17 - 0.21	0.50 - 0.63
Marymoor Parks	1.10	1.70 - 2.10	3.40 - 4.18
Subtotal	**2.82**	**4.36 - 5.40**	**7.46 - 9.22**
Total Future (initial + second) Phase	**3.43**	**5.30 - 6.60**	**8.93 - 11.09**
Potential Agriculture[g]	1.79	3.40	3.40
Total Future + Agriculture[h]	**5.22**	**8.70 – 10.00**	**12.33 - 14.49**

[a]During irrigation period (May – September)
[b]Average day demand estimated from agronomic rates in Washington State. For crops and pastures, an average irrigation rate of 0.33 mgd/100 acres is used, based on irrigation data for potatoes, corn, berries, and turf crops.
[c]Peak day demands (PDD) for first phase customers provided by King County. Minimum PDD based on applying a 1.54 peaking factor (based on agronomic rates) to the average day demand. Maximum PDD based on a 1.54 peaking factor and 80 percent irrigation efficiency for a combined 1.92 peaking factor.
[d]Peaking hour demand (PHD) based on assumed delivery schedule to the customer as presented in previous Carollo Sammamish Valley Reclaimed Water technical memorandums.
[e]Assumes 24-hour per day delivery to storage at the customer site.
[f]Reclaimed water demands provided by King County. Peaking factors modified from Identification of Potential Satellite Projects for Direct Non-Potable Uses (King County, 2000).
[g]Potential agriculture site reclaimed water demands provided by King County.
[h]The nominal capacity is 1.50 mgd for the initial phase, and 10.0 mgd for the future phase. The peak pumping demand is 1.70 mgd for the initial phase, and 10.0 mgd for the future phase.

Conveyance Alternative Development

Two alternative conveyance routes were developed from Brightwater to the Sammamish Valley reclaimed water customers for the initial and future phases. All conveyance routes originate from Portal 41 on the Brightwater combined influent/effluent tunnel. A third alternative conveyance route originating at the Brightwater site and following the Bear Creek sewer trunk was considered, but was not evaluated because portions of the pipe would be installed in an easement parallel to State Route 522. Access to the easement for installing the pipe would be difficult because the Bear Creek sewer trunk is between State Route 522 and several buildings. In addition, the pipe would be within the Riparian Habitat Area for Little Bear Creek, which would require additional environmental studies and mitigation requirements.

In order to develop a consistent reclaimed water system comparison (production facility located in the Sammamish Valley versus conveying reclaimed water from the proposed Brightwater facility), the transmission main from the Brightwater system is generally connected to the conveyance routes presented in TM 11 to each Sammamish Valley reclaimed water customer. Although TM 11 recommended that the reclaimed water production facility be located at the 60-acres site, this comparative analysis is based on the production facility being located at the York Alternative site as described in the York Evaluation. Based on an August 11, 2003 telephone conversation with John Komorita with King County, the conveyance system and conveyance design criteria described in TM 11 are applicable to the York Evaluation. Therefore, identical design criteria from TM 11 were used to develop and evaluate the conveyance system from the proposed Brightwater facility to Sammamish Valley reclaimed water customers. TM 11 was referenced for design criteria, conveyance system sizing criteria, and the conveyance layout approach. These criteria were used where appropriate for the development of the Brightwater reclaimed water system.

In addition to the design criteria used in TM 11, the following assumptions were used to develop the reclaimed water conveyance alternatives from the Brightwater facility.

- The energy grade line in the effluent pipes at Portal 41 would be approximately 80 feet above the ground surface.
- Reclaimed water could be withdrawn directly from the effluent pipes inside the combined tunnel at Portal 41.
- UV disinfection would be required downstream of the reclaimed water pumping station.
- Minimum pressure requirement along the reclaimed water pipe would be approximately 50 feet (20 psi).
- Consistent with TM 11, two duty pumps and one redundant pump are included.

- Based on conversations with the King County conveyance system improvements (CSI) team, a new wastewater pipe is planned to connect the North Creek pump station and Portal 41. Because of the new proposed location for Portal 41 (west side of I-405 at junction of Ross Road and Beardslee Boulevard) and the required depth of this pipe, the entire length of the new wastewater pipe would need to be installed using microtunneling. The reuse pipe would need to be installed using microtunneling to cross under I-405 from the North Creek storage facility, but could be installed using open cut trenching from the west side of I-405 to the new proposed Portal 41 site.
- A portion of the North Creek storage facility could be dedicated to store reclaimed water.
- Based on conversations with the CSI team, the North Creek pump station 30-inch force mains could be used to convey reclaimed water from North Creek to the south to York PS during the summer months. Currently, the force mains are only used during the winter months to convey peak wastewater flows. It is expected that at least one force main would be available for conveying reclaimed water during the summer months through the year 2030. It is assumed that a flushing and disinfection program could be implemented to prepare the force main prior to conveyance of reclaimed water.

Attachment A presents calculation details for the development of the conveyance alternatives.

Reclaimed Water Projects

This section describes the reclaimed water projects evaluated as part of this feasibility study. Each project was developed to be a stand-alone option.

Project Phases

Three phases were analyzed in this feasibility study.

Initial Phase: The conveyance system for this phase is developed to only accommodate initial phase water reuse customers (transmission main diameters not increased to convey potential future flows). The Initial Phase evaluation is not comparable to the York Evaluation cost estimate because the York Evaluation cost estimate accommodated future flow demands. The nominal Initial Phase flow capacity is 1.5 mgd.

Initial Phase A: This evaluation is developed to be directly comparable to the York Evaluation cost estimate. The Initial Phase A conveyance system is sized to accommodate the second phase reclaimed water demands presented in Table 1. Consistent with the York Evaluation initial phase cost estimate, the conveyance system is not sized to include Marymoor Park flow demands. The nominal Initial Phase A flow capacity is 1.5 mgd.

Future Phase: The future phase evaluation is not comparable to the York Evaluation cost estimate because the York Evaluation cost estimate did not estimate costs for future phases. This evaluation includes all of the potential agriculture sites in the area in addition to all of the initial and second phase customers presented in Table 1. The nominal future phase flow capacity is 10.0 mgd.

Conveyance Alternatives

Two alternative conveyance routes were analyzed in this feasibility study.

Alternative 1 – North Creek Force Main: Alternative 1 includes an open cut reclaimed water pipe between Portal 41 and I-405, and a microtunnel installed reclaimed water pipe under I-405 to the North Creek storage facility. The pressure in the effluent pipes at Portal 41 could be used convey reclaimed water from the effluent pipes at Portal 41 to the North Creek storage facility. New reclaimed water pumps installed at the North Creek storage facility would pump reclaimed water from the storage facility to one of the existing North Creek force mains between the North Creek PS and the York PS. Figures 1 and 3 show the reclaimed water conveyance systems for the Alternative 1 Initial Phase (and Initial Phase A) and the Alternative 1 Future Phase, respectively.

Alternative 2 – Sammamish Bike Trail: Alternative 2 includes an open cut reclaimed water pipe between Portal 41 and I-405, and a microtunnel installed reclaimed water pipe under I-405 to the North Creek storage facility. The pressure in the effluent pipes at Portal 41 would be used to convey reclaimed water from the effluent pipes at Portal 41

to the North Creek storage facility. New reclaimed water pumps installed at the North Creek storage facility would pump reclaimed water from the storage facility to a new reclaimed water pipe installed along the Sammamish Bike Trail. Based on field visits, it is assumed that installation of a reclaimed water pipe along the Sammamish Bike Trail would be less disruptive and less expensive than installation of a reclaimed water pipe along 141st Street between Woodinville PS and 124th Street. Figures 2 and 4 show the reclaimed water conveyance systems for the Alternative 2 Initial Phase (and Initial Phase A) and the Alternative 2 Future Phase, respectively.

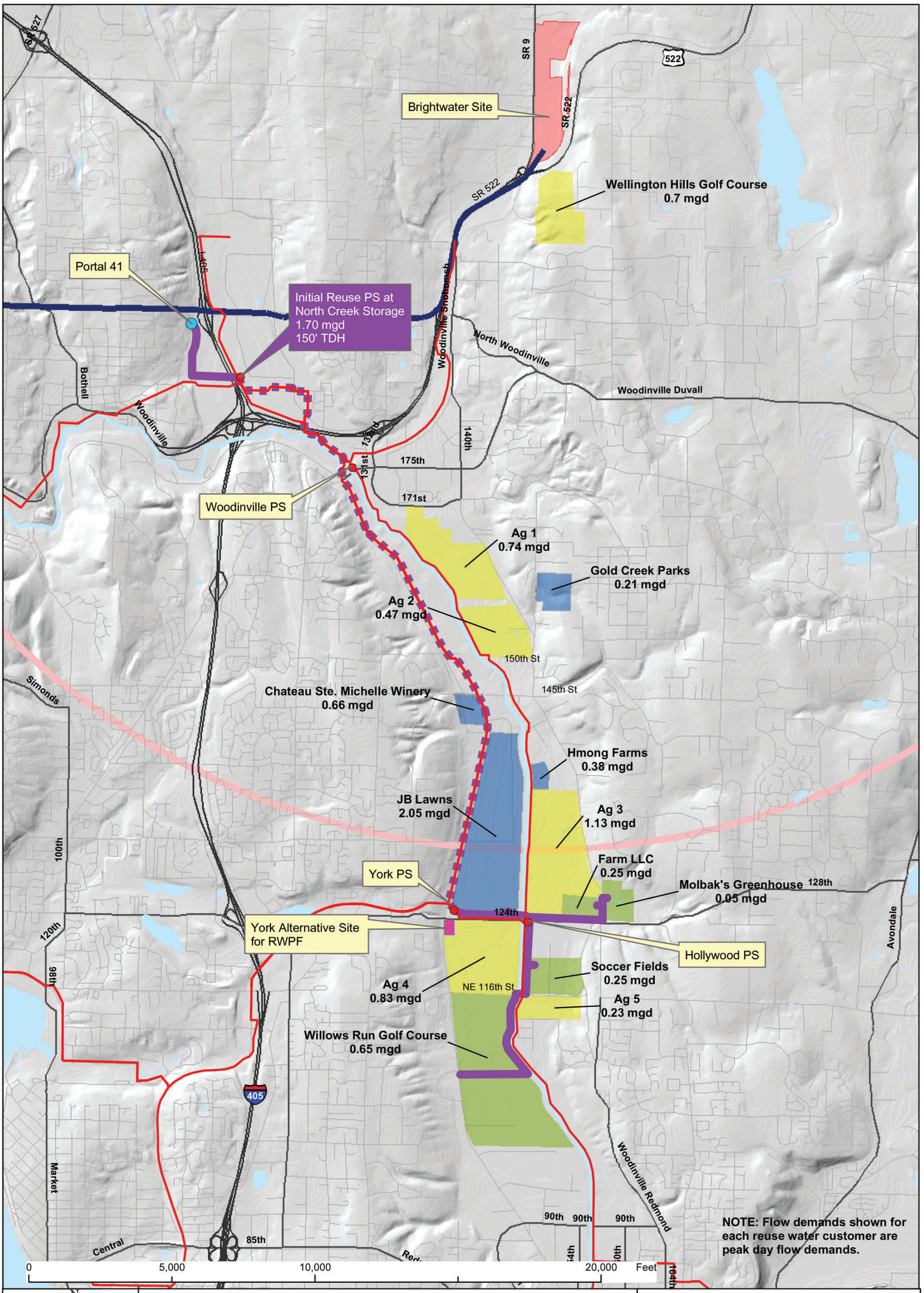


Figure 1
Alternative 1 - Initial Phase & Initial Phase A
Sammamish Valley Reclaimed Water

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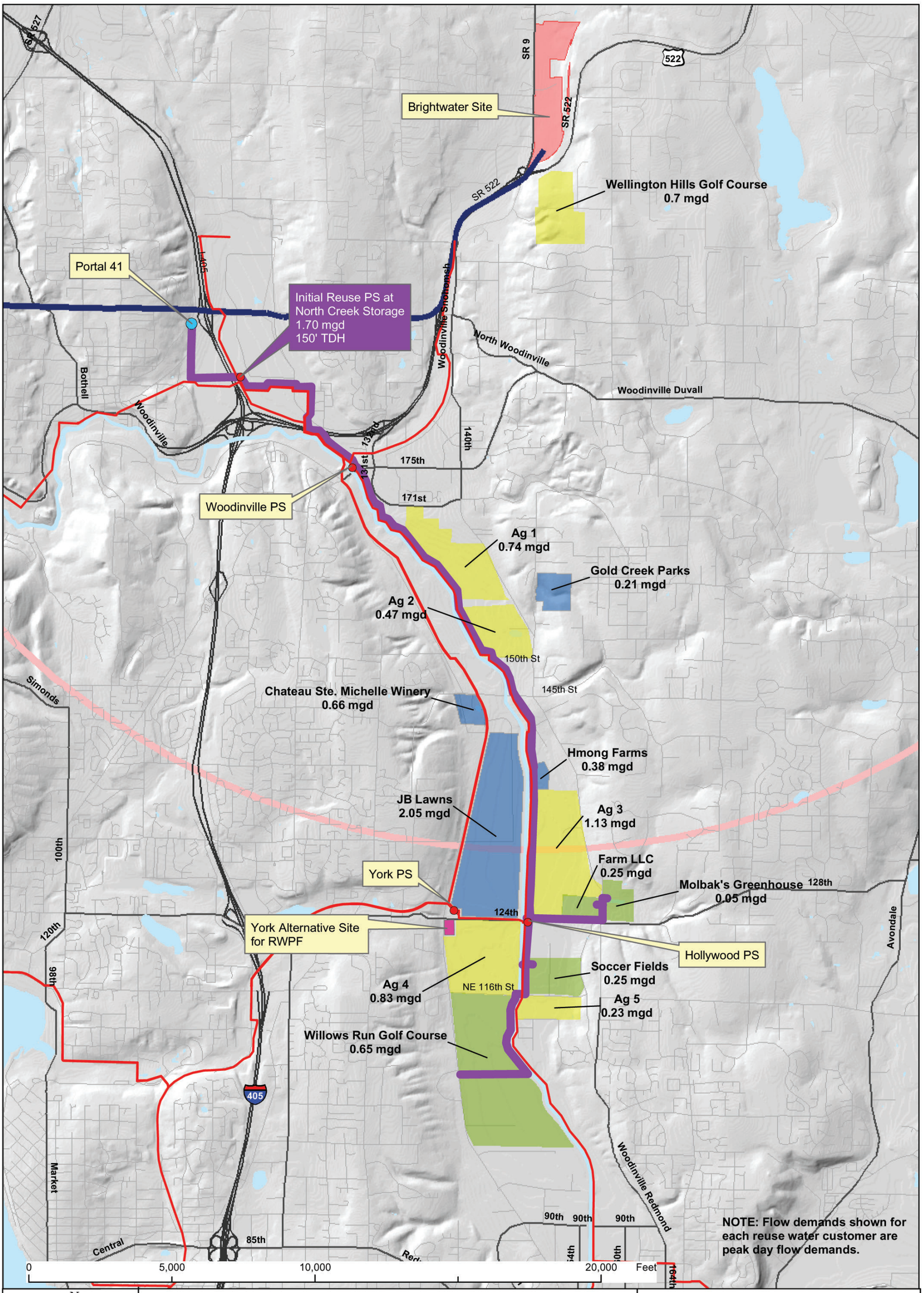

Figure 2
Alternative 2 - Initial Phase & Initial Phase A
Sammamish Valley Reclaimed Water

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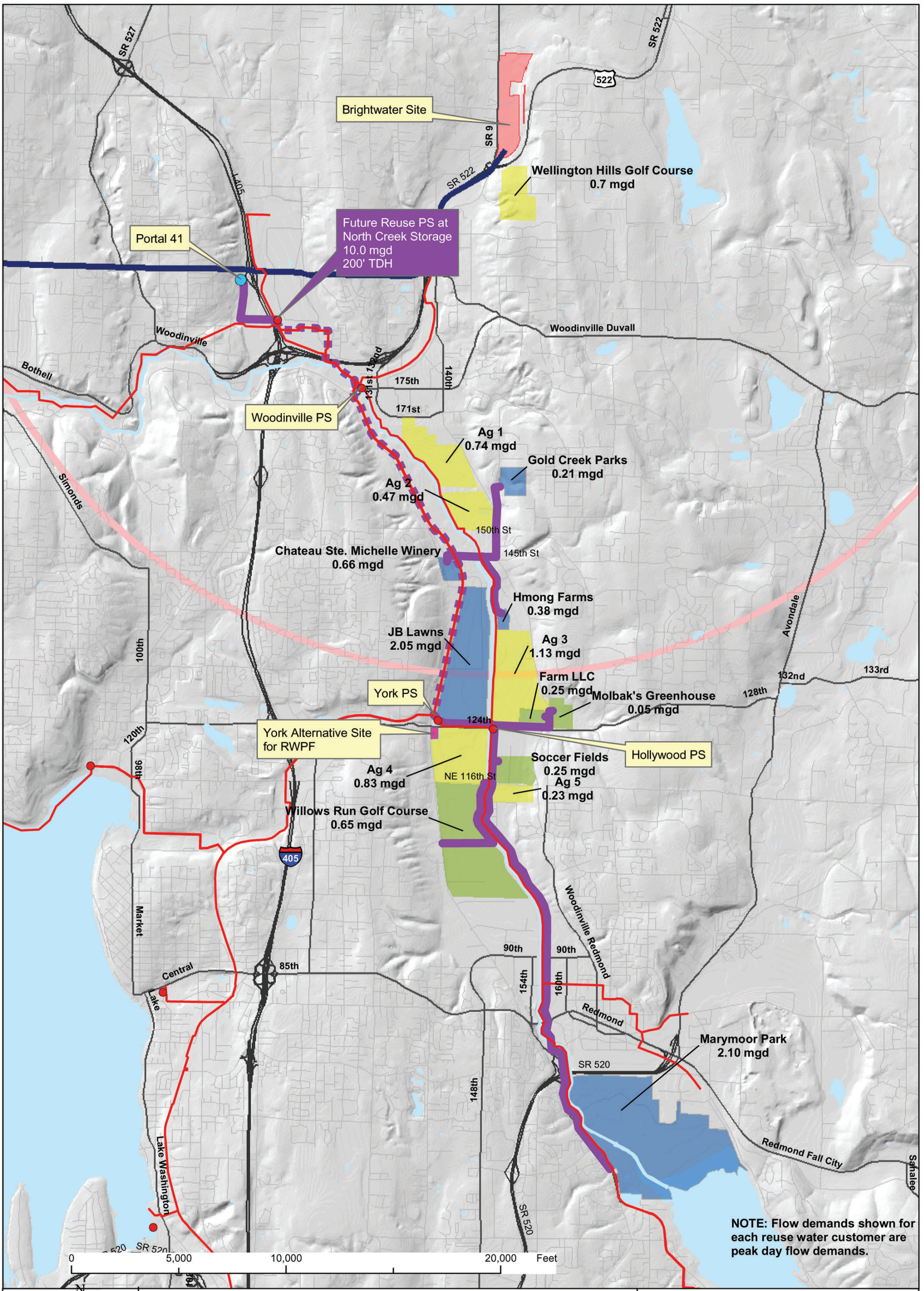

Figure 3
Alternative 1 - Future Phase
Sammamish Valley Reclaimed Water

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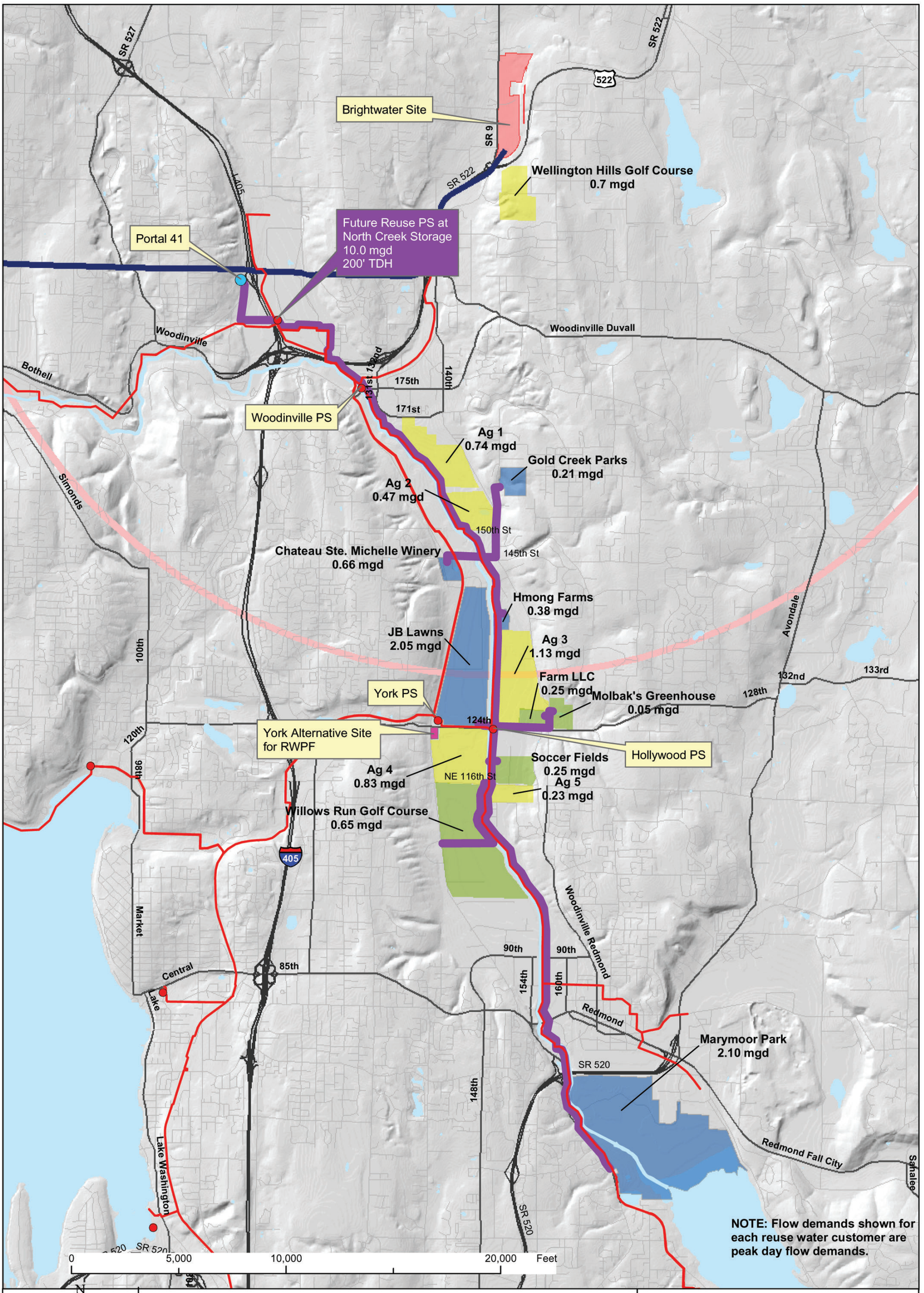

Figure 4
Alternative 2 - Future Phase
Sammamish Valley Reclaimed Water

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Cost Estimate

URS Consultants prepared the capital cost estimates used in this feasibility study, and Brown and Caldwell prepared the operation and maintenance (O&M), annualized, and levelized unit cost estimates. In order to develop a comparable cost estimate, URS Consultants obtained conveyance pipe capital unit costs from TM 11 and applied them to the Brightwater reclaimed water system where appropriate. At this time, the Brightwater project is at more of a planning level than the Sammamish Valley reclaimed water project. Based on an August 11, 2003 telephone conversation with John Komorita with King County, greater contingency factors should be assigned to the Brightwater reclaimed water system than were assigned to the York Evaluation cost estimate. However, in order to develop a comparable cost estimate, Stan Hummel with King County requested that the York Evaluation construction cost estimate be marked up consistent with the cost estimates presented in this feasibility study. Attachment B presents URS Consultant's cost estimating details used in this feasibility study for conveyance pipe, pump stations, and UV disinfection. Table 2 summarizes cost estimate parameters and assumptions used in this feasibility study.

Table 2. Cost Estimating Parameters

Parameter	Assumption	Comment
Construction Contingency*	30%	Applied to base construction cost.
Sales Tax*	8.9%	Applied to base construction cost + construction contingency.
Allied Costs*	35%	Applied to base construction cost + construction contingency + sales tax.
Project Contingency*	25%	Applied to base construction cost.
Interest Rate for Debt Service	6.25%	
Discount Rate	3.0%	Consistent with other Brightwater related cost estimates.
Salvage Value	None	Typically, mechanical systems have no salvage value at the end of their design life. This is a conservative assumption since pipelines and structures typically will last 40 years or longer.
Design Life	20 years	Typical design life for mechanical systems
Power Cost	$0.05/kw-hr	Per King County
Pump Efficiency	75%	
Full Time Equivalent (FTE) Hours per year	1,850	Per King County
Labor Cost	$43	Per King County
Water Reuse Application Months	5 months	Assumed May through September

*Per URS Consultants.

Table 3 presents a capital cost summary, and Table 4 presents an O&M cost summary. Figure 5 presents the total project capital costs, and Figure 6 presents the total annual O&M costs. The project capital costs presented for the future phase projects represent the cost for the total future phase project (as a stand-alone project), not the project cost that would be required addition to the initial phase project costs.

A levelized unit cost was obtained from the ratio of the total annual costs (annual service debt and O&M costs) over the life cycle divided by the total volume of reuse water produced. The water volume was calculated based on the average water demand over the months of May through September. The annual water volume was calculated to be 124,000 CCF (100 ft^3) for the initial phases, and 1,061,000 CCF for the future phase. Figure 7 presents the total annualized cost for each water reuse project alternative, and Figure 8 presents the levelized unit cost for providing reuse water in dollars per hundred cubic feet ($/CCF).

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Table 3: Construction and Project Capital Cost Summary

			2003 Capital[1]																							
			INITIAL PHASE (sized for initial customers only)									INITIAL PHASE A (Comparable to York Evaluation Estimate) (sized for initial + second phase customers excluding Marymoor)									FUTURE PHASE (sized for initial + second phase customers including Ag, Marymoor and JB)							
			Alternative 1 - North Creek Force Main				Alternative 2 - Sammamish Bike Trail						Alternative 1 - North Creek Force Main				Alternative 2 - Sammamish Bike Trail					Alternative 1 - North Creek Force Main				Alternative 2 - Sammamish Bike Trail			
		Cost Items	Diameter, in	Quantity or Length, ft	Unit Price	Cost	Diameter, in	Quantity or Length, ft	Unit Price	Cost	York Evaluation[1]	Diameter, in	Quantity or Length, ft	Unit Price	Cost	Diameter, in	Quantity or Length, ft	Unit Price	Cost	Diameter, in	Quantity or Length, ft	Unit Price	Cost	Diameter, in	Quantity or Length, ft	Unit Price	Cost
CONVEYANCE	Construction Costs	Portal 41 to I-405 Open Cut Pipe	12	3,200	$103	$329,472	12	3,200	$103	$329,472		24	3,200	$207	$663,552	24	3,200	$207	$663,552	30	3,200	$259	$829,440	30	3,200	$259	$829,440
		I-405 to North Creek Microtunnel Pipe	12	500	$2,200	$1,100,000	12	500	$2,200	$1,100,000		24	500	$2,200	$1,100,000	24	500	$2,200	$1,100,000	30	500	$2,200	$1,100,000	30	500	$2,200	$1,100,000
		North Creek to 124th Open Cut Pipe					12	24,700	$102	$2,520,882						24	24,700	$204	$5,029,908					24 to 30	24,700	--	$6,022,653
		Local Reuse Customers Open Cut Pipe	6 to 10	14,800	---	$1,259,988	6 to 10	12,200		$992,292		6 to 16	14,800	---	$1,317,578	6 to 10	12,200	---	$992,292	6 to 24	44,700	--	$5,180,682	6 to 24	40,500	--	$4,373,887
		Bridge Crossing		2	$24,000	$48,000		1	$24,000	$24,000			2	$24,000	$48,000		1	$24,000	$72,000		3	$24,000	$72,000		3	$24,000	$72,000
		Flushing Assembly (to disinfect North Creek FM)		1	$112,000	$112,000							1	$112,000	$112,000						1	$112,000	$112,000				
		Conveyance Construction Costs Sub-Totals				**$2,849,500**				**$4,966,700**					**$3,241,200**				**$7,857,800**				**$7,294,200**				**$12,398,000**
	Other Costs	Construction Contingency @ 30%				$854,850				$1,490,010					$972,360				$2,357,340				$2,188,260				$3,719,400
		Sales Tax @ 8.9%				$329,687				$574,647					$375,007				$909,147				$843,939				$1,434,449
		Allied Costs @ 35%				$1,411,913				$2,460,975					$1,605,998				$3,893,501				$3,614,240				$6,143,147
		Project Contingency @ 25%				$712,375				$1,241,675					$810,300				$1,964,450				$1,823,550				$3,099,500
		Conveyance Other Costs Sub-Totals				**$3,308,900**				**$5,767,400**					**$3,763,700**				**$9,124,500**				**$8,470,000**				**$14,396,500**
	Conveyance Subtotals					**$6,159,000**				**$10,735,000**					**$7,005,000**				**$16,983,000**				**$15,765,000**				**$26,795,000**
			Flow, mgd	Quantity or Head, ft	Unit Price	Cost	Flow, mgd	Quantity or Head, ft	Unit Price	Cost		Flow, mgd	Quantity or Head, ft	Unit Price	Cost	Flow, mgd	Quantity or Head, ft	Unit Price	Cost	Flow, mgd	Quantity or Head, ft	Unit Price	Cost	Flow, mgd	Quantity or Head, ft	Unit Price	Cost
PUMPING STATION	Construction Costs	Reuse PS Mechanical Equipment	1.70	150	$202,500	$202,500	1.70	150	$202,500	$202,500		1.70	150	$202,500	$202,500	1.70	150	$202,500	$202,500	10	200	$672,975	$672,975	10	200	$672,975	$672,975
		Reuse PS Electrical & Instrumentation		1	$40,500	$40,500		1	$40,500	$40,500			1	$40,500	$40,500		1	$40,500	$40,500		1	$134,595	$134,595		1	$134,595	$134,595
		Structural Modifications at North Creek Storage		1	$121,500	$121,500		1	$121,500	$121,500			1	$121,500	$121,500		1	$121,500	$121,500		1	$403,785	$403,785		1	$403,785	$403,785
		Pumping Station Construction Costs Sub-Totals				**$364,500**				**$364,500**					**$364,500**				**$364,500**				**$1,211,400**				**$1,211,400**
	Other Costs	Construction Contingency @ 30%				$109,350				$109,350					$109,350				$109,350				$363,420				$363,420
		Sales Tax @ 8.9%				$42,173				$42,173					$42,173				$42,173				$140,159				$140,159
		Allied Costs @ 35%				$180,608				$180,608					$180,608				$180,608				$600,243				$600,243
		Project Contingency @ 25%				$91,125				$91,125					$91,125				$91,125				$302,850				$302,850
		Pumping Station Other Costs Sub-Totals				**$423,300**				**$423,300**					**$423,300**				**$423,300**				**$1,406,700**				**$1,406,700**
	Pumping Station Subtotals					**$788,000**				**$788,000**					**$788,000**				**$788,000**				**$2,619,000**				**$2,619,000**
			Flow, mgd	Quantity	Unit Price	Cost	Flow, mgd	Quantity	Unit Price	Cost		Flow, mgd	Quantity	Unit Price	Cost	Flow, mgd	Quantity	Unit Price	Cost	Flow, mgd	Quantity	Unit Price	Cost	Flow, mgd	Quantity	Unit Price	Cost
UV DISINFECTION	Construction Costs	UV Mechanical Equipment	1.70	1	$495,000	$495,000	1.70	1	$495,000	$495,000		1.70	1	$495,000	$495,000	1.70	1	$495,000	$495,000	10	1	$1,755,000	$1,755,000	10	1	$1,755,000	$1,755,000
		UV Electrical & Instrumentation		1	$99,000	$99,000		1	$99,000	$99,000			1	$99,000	$99,000		1	$99,000	$99,000		1	$351,000	$351,000		1	$351,000	$351,000
		UV Building Structure		1	$78,750	$78,750		1	$78,750	$78,750			1	$78,750	$78,750		1	$78,750	$78,750		1	$78,750	$78,750		1	$78,750	$78,750
		UV Disinfection Construction Costs Sub-Totals				**$672,800**				**$672,800**					**$672,800**				**$672,800**				**$2,184,800**				**$2,184,800**
	Other Costs	Construction Contingency @ 30%				$201,840				$201,840					$201,840				$201,840				$655,440				$655,440
		Sales Tax @ 8.9%				$77,843				$77,843					$77,843				$77,843				$252,781				$252,781
		Allied Costs @ 35%				$333,369				$333,369					$333,369				$333,369				$1,082,557				$1,082,557
		Project Contingency @ 25%				$168,200				$168,200					$168,200				$168,200				$546,200				$546,200
		UV Disinfection Other Costs Sub-Totals				**$781,300**				**$781,300**					**$781,300**				**$781,300**				**$2,537,000**				**$2,537,000**
	UV Disinfection Subtotals					**$1,454,100**				**$1,455,000**					**$1,455,000**				**$1,455,000**				**$4,722,000**				**$4,722,000**
	Total Project Construction Costs					$3,887,000				$6,004,000	$16,510,000				$4,279,000				$8,896,000				$10,691,000				$15,795,000
	Total Project Other Costs					$4,514,000				$6,972,000	$19,172,000				$4,969,000				$10,330,000				$12,414,000				$18,341,000
	Total Project Costs					**$8,401,000**				**$12,976,000**	**$35,682,000**				**$9,248,000**				**$19,226,000**				**$23,105,000**				**$34,136,000**

[1]Total project construction cost ($16,510,000) for the complete Sammamish Valley Reclaimed Water Production Facility (including conveyance) is per Table 2 of draft *York Alternative Site and Configuration Evaluation* dated May 2003 by Carollo Engineers. The York Evaluation construction cost is marked up to project cost consistent with the Brightwater reclaimed water projects in this feasibility stud. Therefore, the total project cost presented in this table is different than the project cost presented in Table 2 of the York Evaluation ($29,150,000).

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Table 4: Operation and Maintenance Cost Summary

		2003 Annual Operation and Maintenance[1]						
		INITIAL PHASE (sized for initial customers only)		INITIAL PHASE A (Comparable to York Evaluation Estimate) (sized for initial + second phase customers excluding Marymoor)			FUTURE PHASE (sized for initial + second phase customers including Ag, Marymoor and JB)	
	Cost Items	Alternative 1 - North Creek Force Main O&M Cost	Alternative 2 - Sammamish Bike Trail O&M Cost	York Evaluation O&M Cost[5]	Alternative 1 - North Creek Force Main O&M Cost	Alternative 2 - Sammamish Bike Trail O&M Cost	Alternative 1 - North Creek Force Main O&M Cost	Alternative 2 - Sammamish Bike Trail O&M Cost
CONVEYANCE	Operation & Maintenance[4]	$27,000	$33,000		$31,000	$51,000	$70,000	$81,000
	Chemicals (for flushing North Creek FM)[7]	$52,000			$52,000		$52,000	$52,000
	Conveyance Subtotal	**$79,000**	**$33,000**		**$83,000**	**$51,000**	**$122,000**	**$133,000**
PUMPING STATION	Power[3]	$9,000	$9,000		$9,000	$9,000	$64,000	$64,000
	Operation & Maintenance[2]	$3,000	$3,000		$3,000	$3,000	$8,000	$8,000
	Labor[6]	$17,000	$17,000		$17,000	$17,000	$34,000	$34,000
	Pumping Station Subtotal	**$29,000**	**$29,000**		**$29,000**	**$29,000**	**$106,000**	**$106,000**
UV DISINFECTION	Total OM	$5,000	$5,000		$5,000	$5,000	$44,000	$44,000
	UV Disinfection Subtotal	**$5,000**	**$5,000**		**$5,000**	**$5,000**	**$44,000**	**$44,000**
	Total OM Costs	**$113,000**	**$67,000**	**$374,000**	**$117,000**	**$85,000**	**$272,000**	**$283,000**

[1]Assumes water reuse application between the months of May and September.
[2]Includes 0.5% of construction costs for annual O&M.
[3]Assumes $0.05/kw-hr and pump efficiency of 75%.
[4]Includes 0.5% of construction costs for annual O&M. Alternative 1 O&M costs include additional 50% markup to account for operation of flushing system.
[5]Total O&M cost provided by John Komorita with King County in an August 11, 2003 email
[6]Assumed 0.5 FTE for intial phase pump stations, and 1.0 FTE for future phase pump stations during reuse application months.
[7]Assume entire volume of force main between North Creek PS and York PS would require disinfection. Assume disinfection at 1% solution would cost ~ $0.70/gal.

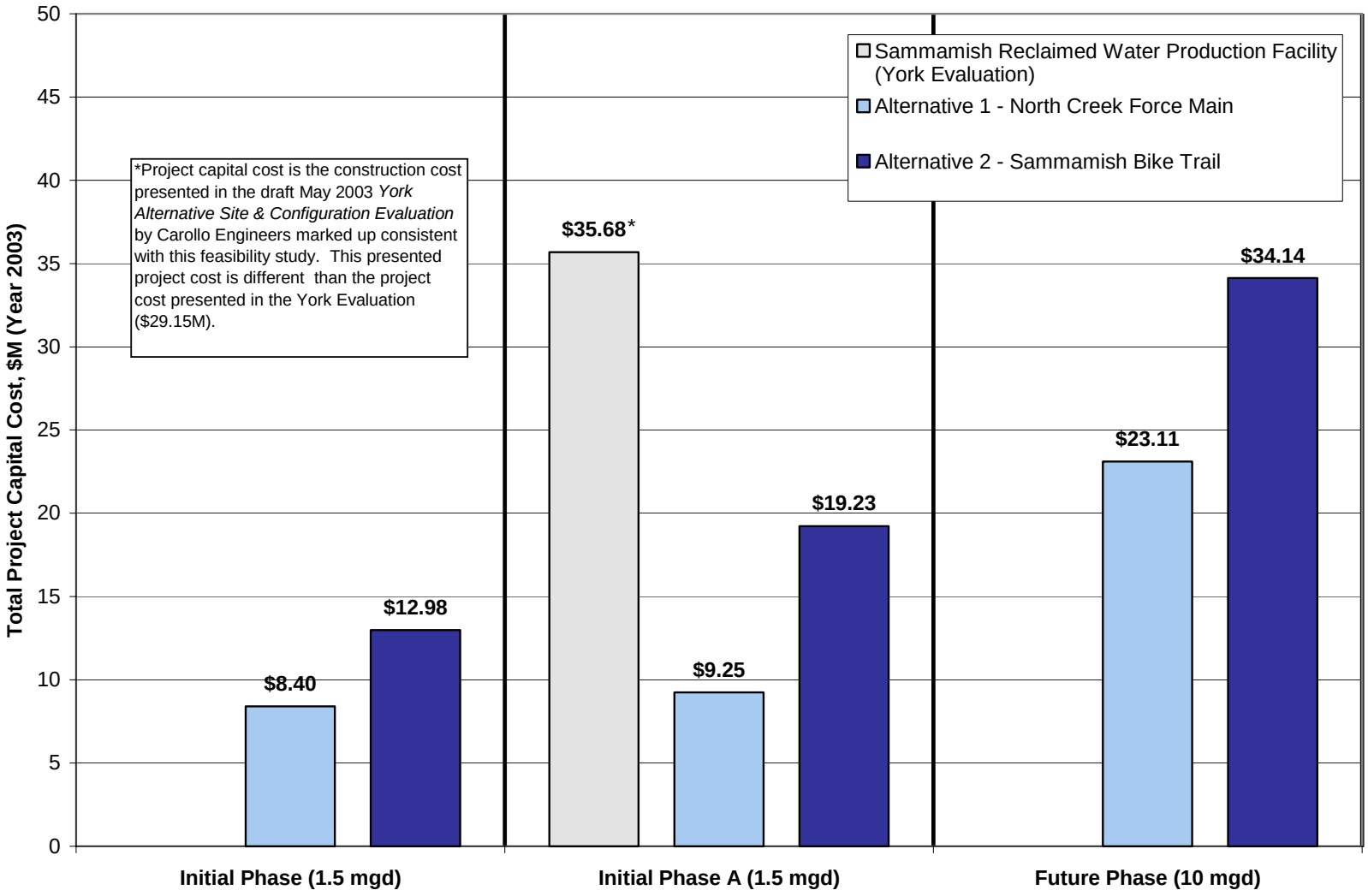

Figure 5: Total Project Capital Costs

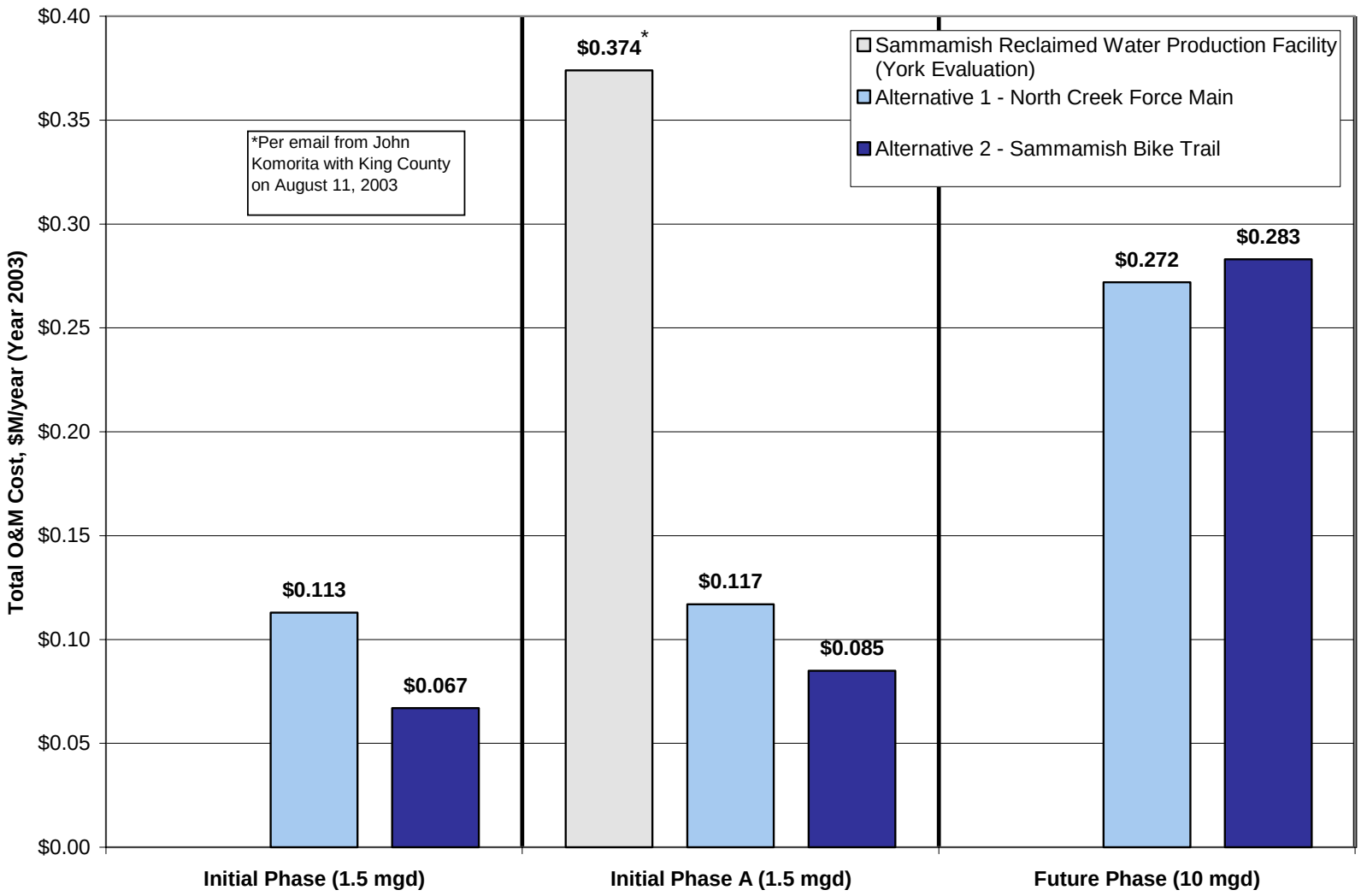

Figure 6: Total O&M Costs

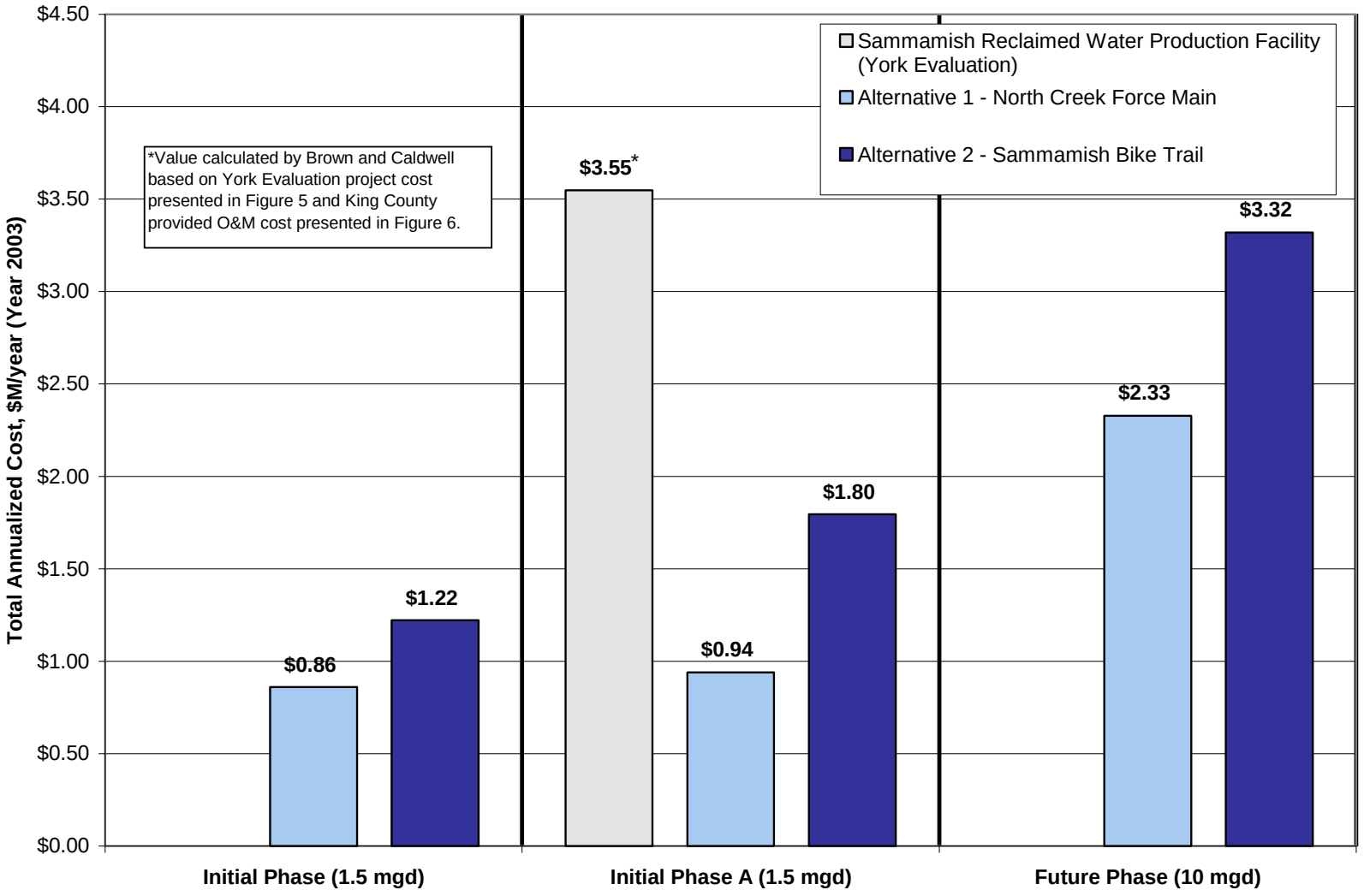

Figure 7: Total Annualized Costs

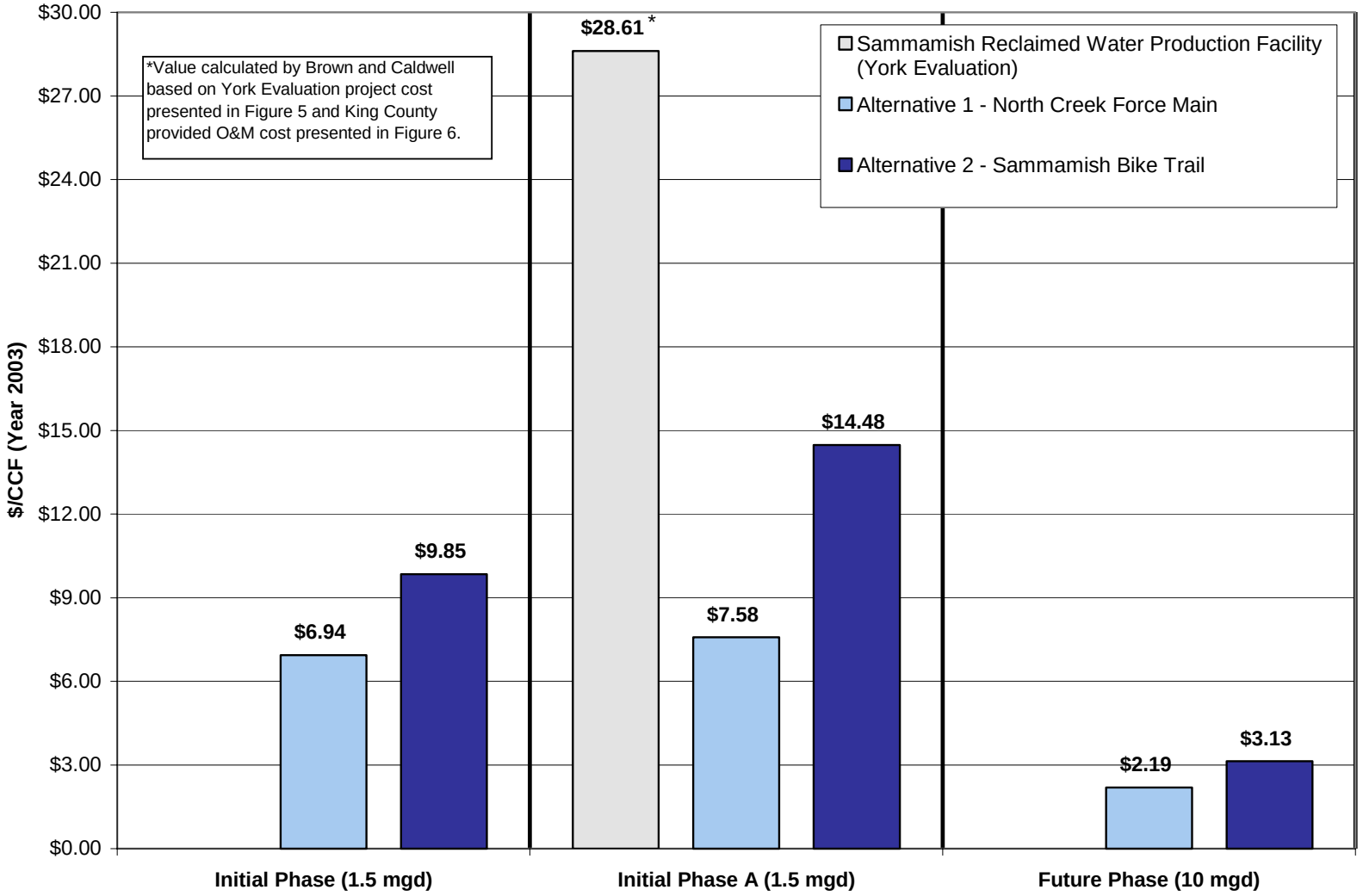

Figure 8: Total Levelized Unit Costs

ATTACHMENT A

Spreadsheets and Calculations

Conveyance
Pump Station
UV Disinfection
Cost Summary

CONVEYANCE

OBJECTIVE

1) Size the conveyance system for the initial phase customers only. NOT comparable to Carollo cost estimate.

2) Size the conveyance system for the initial phase (head-to-head comparison to Carollo cost estimate). Conveyance pipe are to be sized to accommodate future phase flows. Note that Carollo's recommended initial phase conveyance framework (Scenario 2Aa) includes JB Lawns and NOT Marymoor.

3) Size the conveyance system for the future phase. The future phase analysis will NOT be comparable to Carollo's cost estimate.

APPROACH

1) Reference Tech Memo No. 11*Conveyance System Analysis* Final dated December 2002 by Carollo Engineers (TM 11)

2) Per a 7/28/03 meeting with CSI team members (Jim Peterson and Pierre Kwan with HDR) and Stan Hummel and Tom Fox with KC, it was determined that the two 30-inch force mains between North Creek PS and York PS could be used to convey reuse water during the summer months (both force mains are used to convey wastewater during peak winter months). For purposes of this analysis, it is assumed that reuse water will be conveyed in one of the 30-inch force mains during the summer months (Alt 1).

CALCULATIONS

Reclaimed Water Demand
Per Table 11.2 of TM 11

Customers	ADD (mgd)	PDD1 (mgd)	PHD[1] (gpm)	PHD (mgd)[1]	Pump Flow (mgd)[2]	
Initial Phase						
Willows Run	0.32	0.65	450	0.65		
Farm LLC	0.13	0.25	340	0.49		
Soccer Field	0.13	0.25	410	0.59		
Molbaks	0.03	0.05	100	0.14		
Total Initial Phase	0.61	1.20	1,300	1.87	1.68	
Second Phase						
Hmong Farm	0.20	0.38	260	0.37		
JB Lawns	1.07	2.05	1,420	2.04		
Winery	0.34	0.66	1,380	1.99		
Gold Creek	0.11	0.21	440	0.63	5.04	
Marymoor	1.10	2.10	2,900	4.18		
Total Second Phase	2.82	5.40	6,400	9.22		
Total Future (intial + second) Phase	3.43	6.60	7,700	11.09		
Potential Ag	1.79	3.40		3.40		
Total Future Phase + Ag	5.22	10.00		14.49	10.0	7.43

[1]The values in this table are the highest values from the range of values presented in Table 11

[2]Overall system demand based on peaking factors and customer usage throughout the day. See spreadsheets sent by Carollo titled "flow-curves-Phase 1" and "flow-curves-Phase II". Note that Phase II spreadsheet does not include JB Lawns so assumed 5.25 + 4.18 ~ 10.0 mgd

Potential Ag Customers Along Alignments

Potential Customers	Area (ft^2)	Area (ac)	Peak Day Demand (mgd)[1]
ag 1	5,548,348	127	0.74
ag 2	3,497,746	80	0.47
ag 3	8,426,778	193	1.13
ag 4	6,186,290	142	0.83
ag 5	1,677,293	39	0.23
Total of all Ag	25,336,455	582	3.40

[1]Per Tom Fox on 7/25/03, the sum of PDD of the potential customers along the alignment should be approximately 10 mgd - 6.60 mgd ~ 3.4 mgd. Tom indicated that the flows to each Ag area could be ratioed based on area. For Ag land, assumed PHD (for pipe sizing) is the same as PDD.

Conveyance Capital Cost 0%

Base Const to Project Factor = 2.1615

	Year 2003 Traffic Areas/Paved		Year 2003 Open Country/Unpaved		Year 2003 P41 to NC PS	
Diameter (inches)	Base Construction Cost[1] ($/ft)	Project Cost ($/ft)	Base Construction Cost[1] ($/ft)	Project Cost ($/ft)	Base Construction Cost[1] ($/ft)	Project Cost ($/ft)
6	87.6	189	76.0	164		
8	91.4	197	89.7	194		
10	95.5	206	94.7	205		$0
12	103.0	223	102.1	221	2,200	$4,755
14	114.0	246	113.5	245	2,200	$4,755
16	125.1	270	125.0	270	2,200	$4,755
18	135.7	293	132.3	286	2,200	$4,755
20	154.1	333	146.7	317	2,200	$4,755
24	207.4	448	203.6	440	2,200	$4,755
30	259.2	560	254.6	550	2,200	$4,755

Cost for installing pipe on bridge[1]	$24,000	$51,876
Cost for North Creek/York Flushing Assembl[1]	$112,000	$242,088

[1]Per URS cost estimate. Base construction cost increased by 5% to account for estimating contingency.

CONVEYANCE

Conveyance Size

Assumptions:
1) Velocity - consistent with Carollo, pipes will be sized to maintain a minimum velocity of 2 fps and a maximum of 9 fps, and an optimum velocity of 4 to 5 fps.
2) Pipe Diameter - a minimum pipe diameter of 6 inches will be used (note that this criteria may result in velocities < 2 fps)
3) Flow - consistent with Carollo, pipes will be sized based on PHD.
Initial = Willows Golf Course (WRGC), Soccer Fields (SO), Farm LLC (LLC), Molbaks Nursery (MO)
Future = JB Lawns (jb), Marymoor Parks (ma), Chateau Ste. Michelle (ch), Hmong Farms (hm), Goldcreek Parks (gc), Potential Agriculture (ag)

Velocity (fps) 4.5 (used for "Calc'd. Diameter")
Hazen-Williams "C" 130

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Pipe Segment	Future Customer(s) Included	Peak Hour Demand (mgd)	Future PHD in Pipe (mgd)	Max Flow in Pipe for Phase (mgd)	Length (ft)	Calc'd. Diameter (in)	[1]Actual Diameter (in)	Actual Velocity based on Phase Flow (fps)	% Paved	% Unpaved	Number of River Crossings	Project Cost ($M) Paved	Unpaved	Total
Alt 1 (North Creek FM) Initial Phase (sized for initial customers only)														
P41 to I-405	LLC, MO, SO, WRGC		1.68	1.68	3,200	10.3	12	3.3	100%	0%		$0.71		$0.71
I-405 to North Creek	LLC, MO, SO, WRGC		1.68	1.68	500	10.3	12	3.3						$2.38
North Creek to York	LLC, MO, SO, WRGC		1.68	1.68	24,000	10.3	12	3.3				$0.00	$0.00	$0.00
124th West	LLC, MO, SO, WRGC		1.68	1.68	2,600	10.3	12	3.3	100%	0%	1	$0.58	$0.00	$0.58
124th East	LLC, MO		0.63	0.63	3,400	6.3	6	5.0	100%	0%		$0.64	$0.00	$0.64
Farm LLC	LLC	0.49	0.49	0.49	200	5.6	6	3.9	0%	100%		$0.00	$0.03	$0.03
Molbaks	MO	0.14	0.14	0.14	300	3.0	6	1.1	0%	100%		$0.00	$0.05	$0.05
124th to Soccer	SO, WRGC		1.24	1.24	1,600	8.8	10	3.5	0%	100%		$0.00	$0.33	$0.33
Soccer Field	SO	0.59	0.59	0.59	250	6.1	6	4.7	0%	100%		$0.00	$0.04	$0.04
Soccer to 116th	WRGC		0.65	0.65	1,000	6.4	6	5.1	0%	100%		$0.00	$0.16	$0.16
Willows Run	WRGC	0.65	0.65	0.65	5,400	6.4	6	5.1	0%	100%	1	$0.00	$0.89	$0.89
Alternative 1 Initial Phase					**42,450**									**$5.81**
					12,150									
Alt 2 (Samm Bike Trail) Initial Phase (sized for initial customers only)														
P41 to I-405	LLC, MO, SO, WRGC		1.68	1.68	3,200	10.3	12	3.3	100%	0%		$0.71		$0.71
I-405 to North Creek	LLC, MO, SO, WRGC		1.68	1.68	500	10.3	12	3.3						$2.38
North Creek to 124th	LLC, MO, SO, WRGC		1.68	1.68	24,700	10.3	12	3.3	0%	100%		$0.00	$5.45	**$5.45**
124th	LLC, MO		0.63	0.63	3,400	6.3	6	5.0	100%	0%		$0.64	$0.00	$0.64
Farm LLC	LLC	0.49	0.49	0.49	200	5.6	6	3.9	0%	100%		$0.00	$0.03	$0.03
Molbaks	MO	0.14	0.14	0.14	300	3.0	6	1.1	0%	100%		$0.00	$0.05	$0.05
124th to Soccer	SO, WRGC		1.24	1.24	1,600	8.8	10	3.5	0%	100%		$0.00	$0.33	$0.33
Soccer Field	SO	0.59	0.59	0.59	250	6.1	6	4.7	0%	100%		$0.00	$0.04	$0.04
Soccer to 116th	WRGC		0.65	0.65	1,000	6.4	6	5.1	0%	100%		$0.00	$0.16	$0.16
Willows Run	WRGC	0.65	0.65	0.65	5,400	6.4	6	5.1	0%	100%	1	$0.00	$0.89	$0.89
Alternative 2 Initial Phase					**40,550**									**$10.68**
Alt 1 (North Creek FM) Initial Phase A (sized for future customers excluding Marymoor and potential ag)														
P41 to I-405	LLC, MO, SO, WRGC, jb, ch, hm, gc		6.91	1.68	3,200	20.9	24	0.8	100%	0%		$1.43		$1.43
I-405 to North Creek	LLC, MO, SO, WRGC, jb, ch, hm, gc		6.91	1.68	500	20.9	24	0.8						$2.38
North Creek to York	LLC, MO, SO, WRGC, jb, ch, hm, gc		6.91	1.68	24,000	20.9	24	0.8				$0.00	$0.00	$0.00
124th West	LLC, MO, SO, WRGC, jb		3.92	1.68	2,600	15.7	16	1.9	100%	0%	1	$0.70	$0.00	$0.70
124th East	LLC, MO		0.63	0.63	3,400	6.3	6	5.0	100%	0%		$0.64	$0.00	$0.64
Farm LLC	LLC	0.49	0.49	0.49	200	5.6	6	3.9	0%	100%		$0.00	$0.03	$0.03
Molbaks	MO	0.14	0.14	0.14	300	3.0	6	1.1	0%	100%		$0.00	$0.05	$0.05
124th to Soccer	SO, WRGC		1.24	1.24	1,600	8.8	10	3.5	0%	100%		$0.00	$0.33	$0.33
Soccer Field	SO	0.59	0.59	0.59	250	6.1	6	4.7	0%	100%		$0.00	$0.04	$0.04
Soccer to 116th	WRGC		0.65	0.65	1,000	6.4	6	5.1	0%	100%		$0.00	$0.16	$0.16
Willows Run	WRGC	0.65	0.65	0.65	5,400	6.4	6	5.1	0%	100%	1	$0.00	$0.89	$0.89
Alternative 1 Initial Phase A					**42,450**									**$6.66**
					12,150									
Alt 2 (Samm Bike Trail) Initial Phase A (sized for future customers excluding Marymoor and potential ag)														
P41 to I-405	LLC, MO, SO, WRGC, jb, ch, hm, gc		6.91	1.68	3,200	20.9	24	0.8	100%	0%		$1.43		$1.43
I-405 to North Creek	LLC, MO, SO, WRGC, jb, ch, hm, gc		6.91	1.68	500	20.9	24	0.8						$2.38
North Creek to 124th	LLC, MO, SO, WRGC, jb, ch, hm, gc		6.91	1.68	24,700	20.9	24	0.8	0%	100%		$0.00	$10.87	**$10.87**
124th	LLC, MO		0.63	0.63	3,400	6.3	6	5.0	100%	0%		$0.64	$0.00	$0.64
Farm LLC	LLC	0.49	0.49	0.49	200	5.6	6	3.9	0%	100%		$0.00	$0.03	$0.03
Molbaks	MO	0.14	0.14	0.14	300	3.0	6	1.1	0%	100%		$0.00	$0.05	$0.05
124th to Soccer	SO, WRGC		1.24	1.24	1,600	8.8	10	3.5	0%	100%		$0.00	$0.33	$0.33
Soccer Field	SO	0.59	0.59	0.59	250	6.1	6	4.7	0%	100%		$0.00	$0.04	$0.04
Soccer to 116th	WRGC		0.65	0.65	1,000	6.4	6	5.1	0%	100%		$0.00	$0.16	$0.16
Willows Run	WRGC	0.65	0.65	0.65	5,400	6.4	6	5.1	0%	100%	1	$0.00	$0.89	$0.89
Alternative 2 Initial Phase A					**40,550**									**$16.83**
Alt 1 (North Creek FM) Future Phase (includes Marymoor, JB and potential ag)														
P41 to I-405	LLC, MO, SO, WRGC, jb, ch, hm, gc, ma, ags		10.00	10.00	3,200	25.1	30	3.2	100%	0%		$1.79		$1.79
I-405 to North Creek	LLC, MO, SO, WRGC, jb, ch, hm, gc, ma, ags		10.00	10.00	500	25.1	30	3.2						$2.38
North Creek to York	LLC, MO, SO, WRGC, jb, ch, hm, gc, ma, ags		10.00	10.00	24,000	25.1	30	3.2				$0.00	$0.00	$0.00
Winery	ch	1.99	1.99	1.99	700	11.2	12	3.9	50%	50%		$0.08	$0.08	$0.16
145th	gc, hm, ag1, ag2, ag3		3.35	3.35	1,000	14.5	14	4.9	100%	0%	1	$0.25	$0.00	$0.25
Gold Creek	gc, ag1, ag2	0.63	1.85	1.85	4,500	10.8	12	3.6	90%	10%		$0.90	$0.10	$1.00
Hmong Farm	hm, ag3	0.37	1.51	1.51	3,500	9.7	10	4.3	0%	100%		$0.00	$0.72	$0.72
124th West	LLC, MO, SO, WRGC, jb, ma, ag4, ag5		9.62	9.62	2,500	24.6	24	4.7	100%	0%	1	$1.12	$0.00	$1.12
JB Lawns	jb	2.04	2.04	2.04	200	11.4	12	4.0	0%	100%		$0.00	$0.04	$0.04
124th East	LLC, MO		0.63	0.63	3,500	6.3	6	5.0	100%	0%		$0.66	$0.00	$0.66
Farm LLC	LLC	0.49	0.49	0.49	200	5.6	6	3.9	0%	100%		$0.00	$0.03	$0.03
Molbaks	MO	0.14	0.14	0.14	300	3.0	6	1.1	0%	100%		$0.00	$0.05	$0.05
124th to Soccer	SO, WRGC, ma, ag5		5.64	5.64	1,650	18.9	20	4.0	0%	100%		$0.00	$0.52	$0.52
Soccer Field	SO	0.59	0.59	0.59	250	6.1	6	4.7	0%	100%		$0.00	$0.04	$0.04
Soccer to 116th	WRGC, ma, ag5		5.05	5.05	1,000	17.8	20	3.6	0%	100%		$0.00	$0.32	$0.32
Willows Run	WRGC	0.65	0.65	0.65	5,400	6.4	6	5.1	0%	100%	1	$0.00	$0.89	$0.89
Marymoor	ma	4.18	4.18	4.18	20,000	16.2	16	4.6	0%	100%		$0.00	$5.40	$5.40
Alternative 1 Future Phase					**72,400**									**$15.37**
					45,200	0.0								
Alt 2 (Samm Bike Trail) Future Phase (includes Marymoor, JB and potential ag)														
P41 to I-405	LLC, MO, SO, WRGC, jb, ch, hm, gc, ma, ags		10.00	10.00	3,200	25.1	30	3.2	100%	0%		$1.79		$1.79
I-405 to North Creek	LLC, MO, SO, WRGC, jb, ch, hm, gc, ma, ags		10.00	10.00	500	25.1	30	3.2						$2.38
North Creek to 145th	LLC, MO, SO, WRGC, jb, ch, hm, gc, ma, ags		10.00	10.00	16,700	25.1	30	3.2	0%	100%		$0.00	$9.19	**$9.19**
Winery	ch	1.99	1.99	1.99	2,000	11.2	12	3.9	80%	20%	1	$0.36	$0.09	$0.44
Gold Creek	gc, ag1, ag2	0.63	1.85	1.85	4,500	10.8	12	3.6	90%	10%		$0.90	$0.10	$1.00
145th to Hmong	LLC, MO, SO, WRGC, jb, hm, ma, ag3,4,5		6.17	6.17	2,800	19.7	30	1.9	0%	100%		$0.00	$1.54	**$1.54**
Hmong Farm	hm	0.37	0.37	0.37	200	4.9	6	3.0	0%	100%		$0.00	$0.03	$0.03
Hmong to 124th	LLC, MO, SO, WRGC, jb, ma, ag4,5		9.15	9.15	5,200	24.0	24	4.5	0%	100%		$0.00	$2.29	**$2.29**
124th	LLC, MO		0.63	0.63	3,400	6.3	6	5.0	0%	100%	1	$0.00	$0.56	$0.56
Farm LLC	LLC	0.49	0.49	0.49	200	5.6	6	3.9	0%	100%		$0.00	$0.03	$0.03
Molbaks	MO	0.14	0.14	0.14	300	3.0	6	1.1	0%	100%		$0.00	$0.05	$0.05
JB Lawns	jb	2.04	2.04	2.04	750	11.4	12	4.0	0%	100%		$0.00	$0.17	$0.17
124th to Soccer	SO, WRGC, ma, ag5		5.64	5.64	1,650	18.9	20	4.0	0%	100%		$0.00	$0.52	$0.52
Soccer Field	SO	0.59	0.59	0.59	250	6.1	6	4.7	0%	100%		$0.00	$0.04	$0.04
Soccer to 116th	WRGC, ma, ag5		5.05	5.05	1,000	17.8	20	3.6	0%	100%		$0.00	$0.32	$0.32
Willows Run	WRGC	0.65	0.65	0.65	5,400	6.4	6	5.1	0%	100%	1	$0.00	$0.89	$0.89
Marymoor	ma	4.18	4.18	4.18	20,000	16.2	16	4.6	0%	100%		$0.00	$5.40	$5.40
Alternative 2 Future Phase					**68,050**									**$26.64**
				24,700										

[1]Actual diameters are consistent with Carollo where applicable.

PUMPING STATIONS

OBJECTIVE

Calculate PS head and flow and UV system flow requirements.

APPROACH

CALCULATIONS

2.1615

Alternative	Location	ETS Tunnel Depth[1]	PS Elevation	Base Construction Cost[2] $M	Sales Tax $M	Allied Cost $M	OHP $M	Proj Contingency	**Project $M**
Alternative 1 Initial Phase	North Creek Storage		20	$0.36					**$0.79**
Alternative 2 Initial Phase	North Creek Storage		20	$0.36					**$0.79**
Alternative 1 Initial Phase A	North Creek Storage		20	$0.36					**$0.79**
Alternative 2 Initial Phase A	North Creek Storage		20	$0.36					**$0.79**
Alternative 1 Future Phase	North Creek Storage		20	$1.21					**$2.62**
Alternative 2 Future Phase	North Creek Storage		20	$1.21					**$2.62**
	Portal 41 PS	95	45						

2.1615

[1]Per 7/25/03 email from Edith Hadler with HDR

	Input	Comment
Overall Pump Efficiency	75%	assume
PS Maint Cost, % of Const	0.50%	consistent with Year 2000 Reuse evaluation
Annual Pump Usage	42%	assume irrigation season from May through September (5/12 months)

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			Capital Costs			O&M Costs								
Pumping Station	[1]TDH (ft)	Flow (mgd)	Year 2003 Base Const. Capital Cost	Year 2003 Project Capital Cost	Year 2003 Total Project Capital Cost	Annual Pump Station Maintenance Cost	Annual Power Reqts (kw-hr)	Actual Annual Power Reqts (kw-hr)	Annual Pump Power Cost	Labor FTE's Reqd	Actual Annual Labor Hours	Annual Labor Cost	Annual PS OM Cost	Total Annual PS OM Cost
Alternative 1 Initial Phase	150	1.7	$0.36	$0.79	$0.79	$0.0024	385,230	160,512	$8,026	0.50	385	$16,573	$24,599	$24,599
Alternative 2 Initial Phase	150	1.7	$0.36	$0.79	$0.79	$0.0024	385,230	160,512	$8,026	0.50	385	$16,573	$24,599	$24,599
Alternative 1 Initial Phase A	150	1.7	$0.36	$0.79	$0.79	$0.0024	385,230	160,512	$8,026	0.50	385	$16,573	$24,599	$24,599
Alternative 2 Initial Phase A	150	1.7	$0.36	$0.79	$0.79	$0.0024	385,230	160,512	$8,026	0.50	385	$16,573	$24,599	$24,599
Alternative 1 Future Phase	200	10.0	$1.21	$2.62	$2.62	$0.0079	3,057,378	1,273,908	$63,695	1.00	771	$33,146	$96,841	$96,841
Alternative 2 Future Phase	200	10.0	$1.21	$2.62	$2.62	$0.0079	3,057,378	1,273,908	$63,695	1.00	771	$33,146	$96,841	$96,841

[1]See "Initial" and "Future" (profiles) workshee

UV DISINFECTION

							8			11
		0%					2.1615			
Alternative	Design Flow, mgd	Base Construction Cost[1] $M	Sales Tax $M	Allied Cost $M	OHP $M	Proj Conting $M	**Project $M**		O&M/mgd[2] $M	O&M $M
Alternative 1 Initial Phase	1.7	$0.67					**$1.45**		$2,900	$4,872
Alternative 2 Initial Phase	1.7	$0.67					**$1.45**		$2,900	$4,872
Alternative 1 Initial Phase A	1.7	$0.67					**$1.45**		$2,900	$4,872
Alternative 2 Initial Phase A	1.7	$0.67					**$1.45**		$2,900	$4,872
Alternative 1 Future Phase	10.0	$2.18					**$4.72**		$4,333	$43,330
Alternative 2 Future Phase	10.0	$2.18					**$4.72**		$4,333	$43,330

[1]Per 8/21/2003 cost estimate from URS.

[2]Per Dave Murray and Jeff Scarano with BC Portland.

			TCG	August 6, 2003		1/1
Date Checked	Checked By		By	Date	Calc. No.	Sheet
Brightwater		**UV Disinfection**				
Project						

B R O W N A N D C A L D W E L L

BRIGHTWATER RECLAIMED WATER TO SAMMAMISH VALLEY COST SUMMARY

	Assumption	Comment
Discount Rate	3.0%	consistent with other Brightwater related cost estimates
Sales Tax	8.9%	per URS
Project Contingency	25.0%	per URS
Construction Contingency	30.0%	per URS
North Creek FM Flushing OM	50.0%	assume flushing FM for disinfection would require signficant additional OM
Contractor Overhead and Profit	0.0%	included in base unit costs
Allied Costs	35.0%	per URS
Interest Rate for Debt Service	6.25%	assume
Life Cycle, years	20	
Irrigation Period, months/yr	5	
Peak Day to Average Day PF		
Conveyance O&M, % of Const	0.50%	consistent with Year 2000 reuse evaluation
Special X-ing O&M, % of Const	0.50%	
Cost/kw-hr	$0.05	assume per Ron Kohler with KC
Annual Labor Hours/FTE	1,850	assume 1,850 hours/year for 1 FTE per Ron Kohler with KC
Labor cost, $/hr	$43	assume per Ron Kohler with KC
Year 2001 ENR	7,339	
Year 2002/Jan 2003 ENR	7,560	

Alternative	Total Project Cost Capital	Annual O&M	Annual Debt Service	Annual OM Cash Flow	Total Present Worth	CCF Produced /Year	Equiv Annual Cash Flow	Annual Unit Cost per CCF
York Evaluation Initial Phase*	$35.68	$0.374	($3.17)	($0.37)	($39.89)	124,025	($3.55)	($28.61)
Alternative 1 Initial Phase	$8.40	0.113	($0.75)	($0.11)	($9.67)	124,025	($0.86)	($6.94)
Alternative 2 Initial Phase	$12.98	0.067	($1.15)	($0.07)	($13.73)	124,025	($1.22)	($9.85)
Alternative 1 Initial Phase A	$9.25	0.117	($0.82)	($0.12)	($10.56)	124,025	($0.94)	($7.58)
Alternative 2 Initial Phase A	$19.23	0.085	($1.71)	($0.09)	($20.18)	124,025	($1.80)	($14.48)
Alternative 1 Future Phase	$23.11	0.272	($2.06)	($0.27)	($26.16)	1,061,330	($2.33)	($2.19)
Alternative 2 Future Phase	$34.14	0.283	($3.04)	($0.28)	($37.32)	1,061,330	($3.32)	($3.13)

ATTACHMENT B

URS Consultants Capital Cost Estimate Details

Assumptions
Pump Station
UV Disinfection
Flushing Assembly
Conveyance Pipe

URS

Construction Services

Memorandum

Date: August 25, 2003

To: Tadd Giesbrecht

From: Keith Kajiya

Subject: Sammamish Reuse Pipeline and Equipment Costs
P03012P Regional Wastewater Services Plan
Program Management Services Development

Attached are prices (Attachment A1) for various configurations of pipelines based on information prepared by Carollo Engineers for the Sammamish Valley project. Also included are distribution equipment prices for the North Creek/York PS Flushing Assembly, a UV Disinfection Building, and Booster Pumps (Attachments B1-B3). The following general assumptions were made (grouped by pipeline assumptions and distribution equipment assumptions):

Pipeline Unit Cost Assumptions:

1. Unit Prices for pipe installation were developed from the line item descriptions and unit prices used on Carollo Engineer's detailed cost estimate dated 9/10/2002 for scenario 2Aa and 2B (Attachment C1-C2)
2. Cost numbers in the attached spreadsheet listed in a **bold font** designate those that were adjusted above the unit costs from Carollo Engineers for accuracy. These items included costs for Traffic Control, Trench Excavation, Dewatering and Site Restoration.
3. The method of construction was assumed to be based on Figure 11.1 (Attachment D1) for "pipe trench cross section in open country" and Figure 11.2 (Attachment D2) for "pipe trench cross section in paved roadway".
4. The quantities of controlled density fill, imported trench backfill, crushed surfacing base course and asphalt pavement were calculated from the minimum required dimensions shown in Figure 11.1 and 11.2 (Attachments D1-D2) for each of the pipe diameters (8" through 36") for open areas and paved areas.
5. The cost of shoring one side of the pipe trench as shown in Figure 11.1 and 11.2 (Attachments D1-D2) were assumed to be in Carollo Engineer's estimated line cost listed for "trench protection (trench box)".
6. The unit costs were for a minimum length of 1,000 LF.
7. A swell factor of 20% was used for excavation and 10% for compacted control density fill and imported backfill material.
8. The additional earth that was added to widen the bike path 2'-0" was assumed have a slope of 2 to 1.
9. Dewatering pumps were used at all times, but cost for potential major water problems caused by the Sammanish slough was not included.
10. These unit prices assumed that a selected contractor from a publicly open bid project would preform the construction.
11. Unit prices for pipeline items 1A and 2A were for piping to individual water use clients and included an allowance cost for "culvert protection."
12. The construction would take place during the summer months with no delays or interruptions during the construction operation.
13. The unit prices assume a construction contingency percentage of 30%.

URS Corporation
RWSP Program Management
1501 Fourth Avenue, Suite 1400
Seattle, WA 98101-1616
Tel: 206.438.2700
Fax: 206.443.7669

Distribution Equipment Cost Assumptions:

1. Flushing System at North Creek Pump Station: Per Brown and Caldwell 07/30/03 email, flushing system to "plumb" the North Creek and York Pump Stations in a loop with chlorine tablets introduced in the loop. Assumed 4 each, 30 inch knife valves with manual operators, and miscellaneous short pipe sections and fittings.
2. UV Disinfection at North Creek Pump Station: According to Bill Reilly Jr. 08/19/03 email to Tadd Giesbrecht:

   …1.5 mgd expandable to 10 mgd at $275,000 (1 channel, 2 banks,3 models per bank, expandable to 17 modules per bank). This includes the removable baffles for the future expansion.

   5 mgd at $350,000 (1 channel, 2 banks, 9 modules per bank).

   Both designs have been done at a UVT of 70%, an 80,000 does. Redundancy has not been included…

   According to Tadd Giesbrecht 08/20/03 email:
   …New building should be large enough to house electrical for UV and pumps. Reilly Co. advised a 5' wide x 30' long UV channel for 1.5 mgd expandable to 10 mgd, so assume new building approximately 25' x 35' for Initial Phase A (sized for future) and for Future Phase…New building would need a hoist for the UV lamps. Assume architectural treatment similar to existing North Creek PS…

3. Booster Pumping at Portal 41 or North Creek Pump Station: According to Tadd Giesbrecht 08/20/03 email:

   …New reclaimed water pumps don't need an enclosure. Vertical turbine pumps could be set on top of storage facility.

   Add percentage for storage facility structural work to accommodate new reclaimed water pumps…the storage tank cover would need additional bracing, and the 1 MG storage bays could require modifications. Also, there would need to be some work done to provide access to the pumps…

   There are three pumps each for both the "Initial" and "Future" conditions with a combined capacity of 1.5 times the system capacity. The three pump configuration provides two duty pumps and one standby.

   Due to the flow difference between the "Initial" and "Future" conditions, the pumps needed for the "Initial" condition will not be of much use in the "Future" condition. Thus the costs shown for the future conditions is for a complete assembly to accommodate the project "Future" flow. Phasing of the equipment from "Initial" flow to the "Future" flow was not considered.

Should any questions arise, please contact me at 206-438-2182.

Attachments

c: File 8-2.3 Special Studies
Kathy Loland, KC Stan Hummel, KC
Steve Krugel, B&C John Maki, URS
Wally Chen, URS Don Davis, URS

URS Corporation
RWSP Program Management
1501 Fourth Avenue, Suite 1400
Seattle, WA 98101-1616
Tel: 206.438.2700
Fax: 206.443.7669

KING COUNTY

Unit Pipeline Cost Summary

Prorated Carollo Engineers Sammamish Valley Cost Basis

Item	Description	Unit	Unit Cost
1A	6" Pipe, Open Country to specific land plot	LF	$ 66.92
2A	6" Pipe, Traffic Areas to specific land plot	LF	$ 88.05
1	6" Pipe, Open Country	LF	$ 85.01
2	6" Pipe, Traffic Areas	LF	$ 87.05
3	8" Pipe, Open Country	LF	$ 89.71
4	8" Pipe, Traffic Areas	LF	$ 91.35
5	10" Pipe, Open Country	LF	$ 94.67
6	10" Pipe, Traffic Areas	LF	$ 95.51
7	12" Pipe, Open Country	LF	$ 102.06
8	12" Pipe, Traffic Areas	LF	$ 102.96
9	16" Pipe, Open Country	LF	$ 124.97
10	16" Pipe, Traffic Areas	LF	$ 125.11
11	18" Pipe, Open Country	LF	$ 132.34
12	18" Pipe, Traffic Areas	LF	$ 135.72
13	20" Pipe, Open Country	LF	$ 146.72
14	20" Pipe, Traffic Areas	LF	$ 154.08
15	24" Pipe, Open Country	LF	$ 203.64
16	24" Pipe, Traffic Areas	LF	$ 207.36
17	30" Pipe Installed in Existing Trench From Portal 41 to North Creek Pump Station	LF	$ 202.49
18	Bored and Jacked Undercrossing	100 LF	$ 89,000.00
19	Pipe Installation on Bridge	LF	$ 24,000.00
20	Microtunnel	LF	$ 74,000.00

URS Corporation

03_0821 Sammamish Unit Pipeline Costs.xls Summary

Status Date: 8/21/2003

Report Date: 8/25/2003

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

PIPE UNIT COSTS

Unit Costs developed from Carollos unit costs and mark-ups used on Scheme 2Ab and based on Carollo's figure 11.1, dated July 18, 2003.

1A 6" Pipe, Open Country to specific land plot

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**2.00**	10,600	for sammamish trail
Trench Excavation, Open Areas	3,725	CY	**2.50**	9,313	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Open Areas	1,258	CY	56.00	70,448	Swell 10%
Imported Trench Backfill, Open Areas	2,430	CY	21.61	52,512	Swell 10%
Haul and dispose of Trench Earthwork	4,064	CY	12.75	51,816	Swell 20%
Site Restoration	53,000	SF	**0.20**	10,600	
Hydroseeding	38,054	SF	0.11	4,186	7'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
Flow Meter	1	EA	14,000	14,000	
6" CL 150 PVC Pipe	5,300	LF	6.43	34,079	
6" Gate Valve with /box and P.I.	1	EA	1,085.62	1,086	
Back Flow Preventor Assembly, 6"	1	EA	4,417.31	4,417	
Precast BF Preventer Vault	1	EA	8,000	8,000	
SUBTOTAL COST				354,697	
TOTAL COST				354,697	

Unit Cost per lineal foot for 6" Pipe in Open Areas to land plot: $66.92

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

2A 6" Pipe, Traffic Areas to specific land plot

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**10.00**	53,000	for sammamish trail
Trench Excavation, Traffic Areas	3,725	CY	**3.00**	11,175	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Traffic Areas	1,258	CY	60.00	75,480	Swell 10%
Imported Trench Backfill, Traffic Areas	1,643	CY	21.61	35,505	Swell 10%
Haul and dispose of Trench Earthwork	4,064	CY	12.75	51,816	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	3,534	SY	4.85	17,140	6' wide
Install New Crushed Base Course - 6"	590	CY	24.45	14,426	
Install New Top Course - 2"	197	CY	28.67	5,648	
Install Asphalt Paving - 4"	3,534	SY	8.75	30,923	
Site Restoration	53,000	SF	**0.20**	10,600	
Hydroseeding	15,900	SF	0.11	1,749	3'-0" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
Flow Meter	1	EA	14,000	14,000	
6" CL 150 PVC Pipe	5,300	LF	6.43	34,079	
6" Gate Valve with /box and P.I.	1	EA	1,085.62	1,086	
Back Flow Preventor Assembly, 6"	1	EA	4,417.31	4,417	
Precast BF Preventer Vault	1	EA	8,000	8,000	
SUBTOTAL COST				466,676	
TOTAL COST				466,676	

Unit Cost per lineal foot for 6" Pipe in Traffic Areas to land plot: $88.05

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

1 6" Pipe, Open Country

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**2.00**	10,600	for sammamish trail
Trench Excavation, Open Areas	3,725	CY	**2.50**	9,313	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Open Areas	1,258	CY	56.00	70,448	Swell 10%
Imported Trench Backfill, Open Areas	2,430	CY	21.61	52,512	Swell 10%
Haul and dispose of Trench Earthwork	4,064	CY	12.75	51,816	Swell 20%
Site Restoration	53,000	SF	**0.20**	10,600	
Add 2' to Bike Trail	10,600	SF	**11.64**	123,384	
Hydroseeding	38,054	SF	0.11	4,186	7'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
6" CL 150 PVC Pipe	5,300	LF	6.43	34,079	
SUBTOTAL COST				450,579	
TOTAL COST				450,579	

Unit Cost per lineal foot for 6" Pipe in Open Areas: $85.01

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

2 6" Pipe, Traffic Areas

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**10.00**	53,000	for sammamish trail
Trench Excavation, Traffic Areas	3,725	CY	**3.00**	11,175	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Traffic Areas	1,258	CY	65.00	81,770	Swell 10%
Imported Trench Backfill, Traffic Areas	1,643	CY	21.61	35,505	Swell 10%
Haul and dispose of Trench Earthwork	4,064	CY	12.75	51,816	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	3,534	SY	4.85	17,140	6' wide
Install New Crushed Base Course - 6"	590	CY	24.45	14,426	
Install New Top Course - 2"	197	CY	28.67	5,648	
Install Asphalt Paving - 4"	3,534	SY	8.75	30,923	
Site Restoration to Road Shoulder	53,000	SF	**0.50**	26,500	
Hydroseeding	15,900	SF	0.11	1,749	3'-0" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
6" CL 150 PVC Pipe	5,300	LF	6.43	34,079	
SUBTOTAL COST				461,363	
TOTAL COST				461,363	

Unit Cost per lineal foot for 6" Pipe in Traffic Areas: $87.05

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

3 8" Pipe, Open Country

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**2.00**	10,600	for sammamish trail
Trench Excavation, Open Areas	3,835	CY	**2.50**	9,588	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Open Areas	1,339	CY	56.00	74,984	Swell 10%
Imported Trench Backfill, Open Areas	2,430	CY	21.61	52,512	Swell 10%
Haul and dispose of Trench Earthwork	4,184	CY	12.75	53,346	Swell 20%
Site Restoration	53,000	SF	**0.20**	10,600	
Add 2' to Bike Trail	10,600	SF	**11.90**	126,140	
Hydroseeding	38,054	SF	0.11	4,186	7'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
8" CL 150 PVC Pipe	5,300	LF	9.41	49,873	
SUBTOTAL COST				475,470	
TOTAL COST				475,470	

Unit Cost per lineal foot for 8" Pipe in Open Areas: $89.71

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

4 8" Pipe, Traffic Areas

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**10.00**	53,000	for sammamish trail
Trench Excavation, Traffic Areas	3,835	CY	**3.00**	11,505	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Traffic Areas	1,339	CY	65.00	87,035	Swell 10%
Imported Trench Backfill, Traffic Areas	1,636	CY	21.61	35,354	Swell 10%
Haul and dispose of Trench Earthwork	4,184	CY	12.75	53,346	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	3,534	SY	4.85	17,140	6' wide
Install New Crushed Base Course - 6"	590	CY	24.45	14,426	
Install New Top Course - 2"	197	CY	28.67	5,648	
Install Asphalt Paving - 4"	3,534	SY	8.75	30,923	
Site Restoration to Road Shoulder	53,000	SF	**0.50**	26,500	
Hydroseeding	15,900	SF	0.11	1,749	3'-0" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
8" CL 150 PVC Pipe	5,300	LF	9.41	49,873	
SUBTOTAL COST				484,131	
TOTAL COST				484,131	

Unit Cost per lineal foot for 8" Pipe in Traffic Areas: $91.35

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

5 10" Pipe, Open Country

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**2.00**	10,600	for sammamish trail
Trench Excavation, Open Areas	3,835	CY	**2.50**	9,588	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Open Areas	1,297	CY	56.00	72,632	Swell 10%
Imported Trench Backfill, Open Areas	2,430	CY	21.61	52,512	Swell 10%
Haul and dispose of Trench Earthwork	4,184	CY	12.75	53,346	Swell 20%
Site Restoration	53,000	SF	**0.20**	10,600	
Add 2' to Bike Trail	10,600	SF	**12.26**	129,956	
Hydroseeding	38,054	SF	0.11	4,186	7'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
10" CL 150 PVC Pipe	5,300	LF	14.09	74,677	
SUBTOTAL COST				501,738	
TOTAL COST				501,738	

Unit Cost per lineal foot for 10" Pipe in Open Areas: $94.67

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

6 10" Pipe, Traffic Areas

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**10.00**	53,000	for sammamish trail
Trench Excavation, Traffic Areas	3,835	CY	**3.00**	11,505	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Traffic Areas	1,297	CY	65.00	84,305	Swell 10%
Imported Trench Backfill, Traffic Areas	1,636	CY	21.61	35,354	Swell 10%
Haul and dispose of Trench Earthwork	4,184	CY	12.75	53,346	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	3,534	SY	4.85	17,140	6' wide
Install New Crushed Base Course - 6"	590	CY	24.45	14,426	
Install New Top Course - 2"	197	CY	28.67	5,648	
Install Asphalt Paving - 4"	3,534	SY	8.75	30,923	
Site Restoration to Road Shoulder	53,000	SF	**0.50**	26,500	
Hydroseeding	15,900	SF	0.11	1,749	3'-0" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
10" CL 150 PVC Pipe	5,300	LF	14.09	74,677	
SUBTOTAL COST				506,205	
TOTAL COST				506,205	

Unit Cost per lineal foot for 10" Pipe in Traffic Areas: $95.51

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

7 12" Pipe, Open Country

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**2.00**	10,600	for sammamish trail
Trench Excavation, Open Areas	4,049	CY	**2.50**	10,123	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Open Areas	1,466	CY	56.00	82,096	Swell 10%
Imported Trench Backfill, Open Areas	2,430	CY	21.61	52,512	Swell 10%
Haul and dispose of Trench Earthwork	4,417	CY	12.75	56,317	Swell 20%
Site Restoration	53,000	SF	**0.20**	10,600	
Add 2' to Bike Trail	10,600	SF	**12.40**	131,440	
Hydroseeding	38,054	SF	0.11	4,186	7'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
12" CL 150 PVC Pipe	5,300	LF	18.76	99,428	
SUBTOTAL COST				540,942	
TOTAL COST				540,942	

Unit Cost per lineal foot for 12" Pipe in Open Areas: $102.06

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

8 12" Pipe, Traffic Areas

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**10.00**	53,000	for sammamish trail
Trench Excavation, Traffic Areas	4,049	CY	**3.00**	12,147	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Traffic Areas	1,466	CY	65.00	95,290	Swell 10%
Imported Trench Backfill, Traffic Areas	1,643	CY	21.61	35,505	Swell 10%
Haul and dispose of Trench Earthwork	4,417	CY	12.75	56,317	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	3,534	SY	4.85	17,140	6' wide
Install New Crushed Base Course - 6"	590	CY	24.45	14,426	
Install New Top Course - 2"	197	CY	28.67	5,648	
Install Asphalt Paving - 4"	3,534	SY	8.75	30,923	
Site Restoration to Road Shoulder	53,000	SF	**0.50**	26,500	
Hydroseeding	15,900	SF	0.11	1,749	3'-0" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
12" CL 150 PVC Pipe	5,300	LF	18.76	99,428	
SUBTOTAL COST				545,705	
TOTAL COST				545,705	

Unit Cost per lineal foot for 12" Pipe in Traffic Areas: $102.96

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

9 16" Pipe, Open Country

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**2.00**	10,600	for sammamish trail
Trench Excavation, Open Areas	5,021	CY	**2.50**	12,553	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**6.00**	31,800	
Control Density Fill, Open Areas	1,990	CY	56.00	111,440	Swell 10%
Imported Trench Backfill, Open Areas	2,753	CY	21.61	59,492	Swell 10%
Haul and dispose of Trench Earthwork	5,477	CY	12.75	69,832	Swell 20%
Site Restoration	53,000	SF	**0.20**	10,600	
Add 2' to Bike Trail	10,600	SF	**13.58**	143,948	
Hydroseeding	42,400	SF	0.11	4,664	8'-0"" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
16" CL 150 PVC Pipe	5,300	LF	29.20	154,760	
SUBTOTAL COST				662,324	
TOTAL COST				662,324	

Unit Cost per lineal foot for 16" Pipe in Open Areas: $124.97

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

10 16" Pipe, Traffic Areas

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**10.00**	53,000	for sammamish trail
Trench Excavation, Traffic Areas	5,021	CY	**3.00**	15,063	Swell 10%
Trench Protection (Trench Box)	5,300	LF	6.75	35,775	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Traffic Areas	1,990	CY	65.00	129,350	Swell 10%
Imported Trench Backfill, Traffic Areas	1,898	CY	21.61	41,016	Swell 10%
Haul and dispose of Trench Earthwork	5,477	CY	12.75	69,832	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	3,828	SY	4.85	18,566	6'-6" wide
Install New Crushed Base Course - 6"	638	CY	24.45	15,599	
Install New Top Course - 2"	217	CY	28.67	6,221	
Install Asphalt Paving - 4"	3,828	SY	8.75	33,495	
Site Restoration to Road Shoulder	53,000	SF	**0.50**	26,500	
Hydroseeding	18,550	SF	0.11	2,041	3'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
16" CL 150 PVC Pipe	5,300	LF	29.20	154,760	
SUBTOTAL COST				663,075	
TOTAL COST				663,075	

Unit Cost per lineal foot for 16" Pipe in Traffic Areas: $125.11

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

11 18" Pipe, Open Country

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**2.00**	10,600	for sammamish trail
Trench Excavation, Open Areas	5,021	CY	**2.50**	12,553	Swell 10%
Trench Protection (Trench Box)	5,300	LF	**7.00**	37,100	
Dewatering	5,300	LF	**6.00**	31,800	
Control Density Fill, Open Areas	1,920	CY	56.00	107,520	Swell 10%
Imported Trench Backfill, Open Areas	2,753	CY	21.61	59,492	Swell 10%
Haul and dispose of Trench Earthwork	5,477	CY	12.75	69,832	Swell 20%
Site Restoration	53,000	SF	**0.20**	10,600	
Add 2' to Bike Trail	10,600	SF	**14.07**	149,142	
Hydroseeding	42,400	SF	0.11	4,664	8'-0"" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
18" CL 150 PVC Pipe	5,300	LF	36.08	191,224	
SUBTOTAL COST				701,387	
TOTAL COST				701,387	

Unit Cost per lineal foot for 18" Pipe in Open Areas: $132.34

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

12 18" Pipe, Traffic Areas

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**10.00**	53,000	for sammamish trail
Trench Excavation, Traffic Areas	5,021	CY	**3.00**	15,063	Swell 10%
Trench Protection (Trench Box)	5,300	LF	**7.00**	37,100	
Dewatering	5,300	LF	**5.85**	31,005	
Control Density Fill, Traffic Areas	1,990	CY	65.00	129,350	Swell 10%
Imported Trench Backfill, Traffic Areas	2,753	CY	21.61	59,492	Swell 10%
Haul and dispose of Trench Earthwork	5,477	CY	12.75	69,832	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	3,828	SY	4.85	18,566	6'-6" wide
Install New Crushed Base Course - 6"	638	CY	24.45	15,599	
Install New Top Course - 2"	217	CY	28.67	6,221	
Install Asphalt Paving - 4"	3,828	SY	8.75	33,495	
Site Restoration to Road Shoulder	53,000	SF	**0.50**	26,500	
Hydroseeding	18,550	SF	0.11	2,041	3'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
18" CL 150 PVC Pipe	5,300	LF	36.08	191,224	
SUBTOTAL COST				719,341	
TOTAL COST				719,341	

Unit Cost per lineal foot for 18" Pipe in Traffic Areas: $135.72

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

13 20" Pipe, Open Country

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**2.50**	13,250	for sammamish trail
Trench Excavation, Open Areas	6,100	CY	**3.00**	18,300	Swell 10%
Trench Protection (Trench Box)	5,300	LF	**7.50**	39,750	
Dewatering	5,300	LF	**6.00**	31,800	
Control Density Fill, Open Areas	2,598	CY	56.00	145,488	Swell 10%
Imported Trench Backfill, Open Areas	3,077	CY	21.61	66,494	Swell 10%
Haul and dispose of Trench Earthwork	6,655	CY	12.75	84,851	Swell 20%
Site Restoration	53,000	SF	**0.20**	10,600	
Add 2' to Bike Trail	10,600	SF	**14.56**	154,336	
Hydroseeding	42,400	SF	0.11	4,664	8'-0"" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
20" CL 150 PVC Pipe	5,300	LF	36.08	191,224	
SUBTOTAL COST				777,618	
TOTAL COST				777,618	

Unit Cost per lineal foot for 20" Pipe in Open Areas: $146.72

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

14 20" Pipe, Traffic Areas

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	5,890	SY	0.22	1,296	10' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**10.00**	53,000	for sammamish trail
Trench Excavation, Traffic Areas	6,100	CY	**3.00**	18,300	Swell 10%
Trench Protection (Trench Box)	5,300	LF	**7.50**	39,750	
Dewatering	5,300	LF	**6.00**	31,800	
Control Density Fill, Traffic Areas	2,598	CY	65.00	168,870	Swell 10%
Imported Trench Backfill, Traffic Areas	2,222	CY	21.61	48,017	Swell 10%
Haul and dispose of Trench Earthwork	6,655	CY	12.75	84,851	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	3,828	SY	4.85	18,566	6'-6" wide
Install New Crushed Base Course - 6"	638	CY	24.45	15,599	
Install New Top Course - 2"	217	CY	28.67	6,221	
Install Asphalt Paving - 4"	3,828	SY	8.75	33,495	
Site Restoration to Road Shoulder	53,000	SF	**0.50**	26,500	
Hydroseeding	18,550	SF	0.11	2,041	3'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
20" CL 150 PVC Pipe	5,300	LF	45.05	238,765	
SUBTOTAL COST				816,628	
TOTAL COST				816,628	

Unit Cost per lineal foot for 20" Pipe in Traffic Areas: $154.08

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

15 24" Pipe, Open Country

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	6,478	SY	0.22	1,425	11' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**3.00**	15,900	for sammamish trail
Trench Excavation, Open Areas	8,961	CY	**3.00**	26,883	Swell 10%
Trench Protection (Trench Box)	5,300	LF	**8.00**	42,400	
Dewatering	5,300	LF	**7.00**	37,100	
Control Density Fill, Open Areas	4,782	CY	56.00	267,792	Swell 10%
Imported Trench Backfill, Open Areas	3,563	CY	21.61	76,996	Swell 10%
Haul and dispose of Trench Earthwork	6,655	CY	12.75	84,851	Swell 20%
Site Restoration	58,300	SF	**0.20**	11,660	
Add 2' to Bike Trail	10,600	SF	**15.05**	159,530	
Hydroseeding	47,700	SF	0.11	5,247	9'-0"" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
24" CL 150 PVC Pipe	5,300	LF	63.01	333,953	
SUBTOTAL COST				1,079,303	
TOTAL COST				1,079,303	

Unit Cost per lineal foot for 24" Pipe in Open Areas: $203.64

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

16 24" Pipe, Traffic Areas

			Unit Cost	Total	
Clearing and Grubbing, Grass Sod	6,478	SY	0.22	1,425	11' per LF
Metallic Location Tape	5,300	LF	1.05	5,565	1 per LF
Traffic Control	5,300	LF	**12.00**	63,600	for sammamish trail
Trench Excavation, Traffic Areas	8,961	CY	**3.00**	26,883	Swell 10%
Trench Protection (Trench Box)	5,300	LF	**8.00**	42,400	
Dewatering	5,300	LF	**7.00**	37,100	
Control Density Fill, Traffic Areas	4,782	CY	65.00	310,830	Swell 10%
Imported Trench Backfill, Traffic Areas	2,642	CY	21.61	57,094	Swell 10%
Haul and dispose of Trench Earthwork	6,655	CY	12.75	84,851	Swell 20%
Cut Asphalt Pavement	5,300	LF	2.64	13,992	LF of trench
Remove Pavement	4,122	SY	4.85	19,992	7'-0" wide
Install New Crushed Base Course - 6"	687	CY	24.45	16,797	
Install New Top Course - 2"	234	CY	28.67	6,709	
Install Asphalt Paving - 4"	4,122	SY	8.75	36,068	
Site Restoration to Road Shoulder	58,300	SF	**0.50**	29,150	
Hydroseeding	23,850	SF	0.11	2,624	4'-6" Wide
Culvert Protection Allowance	1	EA	10,000	10,000	
24" CL 150 PVC Pipe	5,300	LF	63.01	333,953	
SUBTOTAL COST				1,099,032	
TOTAL COST				1,099,032	

Unit Cost per lineal foot for 24" Pipe in Traffic Areas: $207.36

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

17 30" Pipe Installed in Existing Trench From Portal 41 to North Creek Pump Station

Assumptions:
4,525 LF of 30" Pipe
1,700 LF is along roadway
Trench Depth 10',
Extra Width 9'

			Unit Cost	Total
Clearing and Grubbing, Grass Sod	5,028	SY	0.22	1,106
Trench Excavation	16,592	CY	**1.50**	24,888
Trench Protection	4,525	LF	2.00	9,050
Dewatering	4,525	LF	**1.00**	4,525
Control Density Fill	9,133	CY	65.00	593,645
Imported Trench Backfill	5,514	CY	21.61	119,158
Haul and dispose of Trench Earthwork	18,100	CY	12.75	230,775
Site Restoration	40,725	SF	**0.50**	20,363
Cut Asphalt Pavement	1,700	LF	2.64	4,488
Remove Pavement	5,028	SY	4.85	24,386
Install New Crushed Base Course - 6"	838	CY	24.45	20,489
Install New Top Course - 2"	285	CY	28.67	8,171
Install Asphalt Paving - 4"	5,028	SY	8.75	43,995
Hydroseeding	40,725	SF	0.11	4,480
30" CL 150 PVC Pipe	4,525	LF	77.00	348,425
SUBTOTAL COST				1,457,943
TOTAL COST				1,457,943

Unit Cost per lineal foot for 30" Pipe in Existing Trench: $202.49

KING COUNTY

Unit Pipeline Cost Detail

Prorated Carollo Engineers Sammamish Valley Cost Basis

18 Bored and Jacked Undercrossing

Bored and Jacked Undercrossing	100 LF	850.65	85,065
Traffic Control	100 LF	12.00	1,200
Site Resoration allowance for bridge and area	100 LF	25.00	2,500
SUBTOTAL COST			88,765
TOTAL COST			**89,000**

19 Pipe Installation on Bridge

Pipe Installation on Bridge	100 LF	200.00	20,000
Traffic Control	100 LF	12.00	1,200
Site Resoration allowance for bridge and area	100 LF	25.00	2,500
SUBTOTAL COST			23,700
TOTAL COST			**24,000**

20 Microtunnel

Microtunnel	1 LF	2,200.00	2,200
Assumes procurement of Microtunnel TBM is from the Brightwater Influent Pipeline			
SUBTOTAL COST			73,600
TOTAL COST			**74,000**

KING COUNTY

North Creek/York PS Flushing Assembly

ALTERNATIVE 1 INITIAL ONLY

Division	Description	QTY.	Unit	Unit Price	Install Adj.	Total
15	Mechanical					
	30-inch knife valve	4	ea	$10,000	1.40	$56,000
	misc. mechanical (100% of total mechanical	100%	LS	$56,000	1.00	$56,000
	Construction Subtotal					$112,000
	Construction Cost					$112,000
	Total Project Cost					$112,000

URS Corporation

03_0821 Sammamish Unit Pipeline Costs.xls

Status Date: 8/21/2003

Report Date: 8/25/2003

KING COUNTY

UV Disinfection Building Equipment

ALL ALTERNATIVES INITIAL (1.7 mgd) ONLY

Division	Description	QTY.	Unit	Unit Price	Install Adj.	Total
15	Mechanical					
	Channel UV disinfection	1	LS	$275,000	1.50	$412,500
	misc. mechanical (20% of total mechanical)	20%	LS	$82,500	1.00	$82,500
16	Electrical & Instrumentation					
	Assume 20% of Mechanical Costs	20%	LS	$99,000	1.00	$99,000
17	UV Building Structure	875	SF	$90	1.00	$78,750
	Construction Subtotal					$672,750
	Construction Cost					$672,750
	Total Project Cost					$672,750

ADDITIONAL COST FOR ALL ALTERNATIVES FUTURE (10 mgd) ONLY

Division	Description	QTY.	Unit	Unit Price	Install Adj.	Total
15	Mechanical					
	Channel UV disinfection	1	LS	$700,000	1.50	$1,050,000
	misc. mechanical (20% of total mechanical)	20%	LS	$210,000	1.00	$210,000
16	Electrical & Instrumentation					
	Assume 20% of Mechanical Costs	20%	LS	$252,000	1.00	$252,000
17	UV Building Structure	875	SF	$90	1.00	$78,750
	Construction Subtotal					$1,590,750
	Estimating Contingency	30%				$477,225
	Construction Cost					$2,067,975
	Total Project Cost					$2,067,975

URS Corporation

03_0821 Sammamish Unit Pipeline Costs.xls UV Disinfection

Status Date: 8/21/2003

Report Date: 8/25/2003

KING COUNTY

Booster Pumps

ALL ALTERNATIVES INITIAL (1.7 mgd) ONLY

Division	Description	QTY.	Unit	Unit Price	Install Adj.	Total
15	Mechanical					
	Pump Assembly	3	ea	$22,500	1.50	$101,250
	misc. mechanical (100% of total mechanical)	100%	LS	$101,250	1.00	$101,250
16	Electrical & Instrumentation					
	Assume 20% of Mechanical Costs	20%	LS	$40,500	1.00	$40,500
	Allowance for storage facility structural work accommodate new reclaimed water pumps.	50%	LS	$121,500	1.00	$121,500
	Construction Subtotal					$364,500
	Construction Cost					$364,500
	Total Project Cost					$364,500

ADDITIONAL COST FOR ALL ALTERNATIVES FUTURE (10 mgd) ONLY

Division	Description	QTY.	Unit	Unit Price	Install Adj.	Total
15	Mechanical					
	Pump Assembly	3	ea	$69,700	1.50	$313,650
	misc. mechanical (50% of total mechanical)	50%	LS	$156,825	1.00	$156,825
16	Electrical & Instrumentation					
	Assume 20% of Mechanical Costs	20%	LS	$94,095	1.00	$94,095
	Allowance for storage facility structural work accommodate new reclaimed water pumps.	50%	LS	$282,285	1.00	$282,285
	Construction Subtotal					$846,855
	Estimating Contingency	30%				$254,057
	Construction Cost					$1,100,912
	Total Project Cost					$1,100,912

URS Corporation

03_0821 Sammamish Unit Pipeline Costs.xls

Status Date: 8/21/2003

Report Date: 8/25/2003

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DETAILED COST ESTIMATE

Attachment C1

PROJECT : Sammamish Valley RWPF

JOB # : 6700A.10

DATE : 9/10/2002

LOCATION : Seattle, WA Area

BY : GLS/DVK

ELEMENT : West 60-Acres South - Scenario 2Aa

REVIEWED BY:

Initial

CUMULATIVE

SPEC	DL	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
2		**SITEWORK**					
		Clearing & Grubbing, Grass & Sod	8198	SY	$0.22	$2,000	$2,000
		Trench Exc, Tracked Hoe, Open Areas	6855	CY	$1.58	$11,000	$13,000
		Trench Exc, Tracked Hoe, Traffic Areas	1641	CY	$2.17	$4,000	$17,000
		Trench Protection	10200	LF	$6.75	$69,000	$86,000
		Dewatering (Pump & Haul to Sewer)	10200	LF	$5.85	$60,000	$146,000
		CDF Pipe Zone (Open Areas)	2166	CY	$56.00	$121,000	$267,000
		CDF Pipe Zone (Traffic Areas)	556	CY	$60.00	$33,000	$300,000
		Imported Trench Backfill	5008	CY	$21.61	$108,000	$408,000
		Haul & Dispose Trench Spoils (1.2 Bulking Factor)	10195	CY	$12.75	$130,000	$538,000
		Cut AC Pavement, 4" Thick	1780	LF	$2.64	$5,000	$543,000
		Remove AC Pavement	2373	SY	$4.85	$12,000	$555,000
		Crushed Surfacing Base Course, 6"	213	CY	$24.45	$5,000	$560,000
		Crushed Surfacing Top Course, 2"	71	CY	$28.67	$2,000	$562,000
		AC Paving, Class B, 4" Thick	791	SY	$8.75	$7,000	$569,000
		Hydroseeding	52420	SF	$0.11	$6,000	$575,000
		Purple Metallic Location Tape	10200	LF	$1.05	$11,000	$586,000
		Traffic Control, Allow	1780	LF	$10.00	$18,000	$604,000
		Culvert Protection	3	EA	$10,000	$30,000	$634,000
		Bored and Jacked Undercrossing	150	LF	$850.65	$128,000	$762,000
13		**SPECIAL CONSTRUCTION**					
		Flow Meter	4	EA	$14,000.00	$56,000	$818,000
15		**MECHANICAL**					
		6" CL 150 PVC Pipe	7300	LF	$6.43	$47,000	$865,000
		8" CL 150 PVC Pipe	0	LF	$9.41	$0	$865,000
		12" CL 150 PVC Pipe	0	LF	$18.76	$0	$865,000
		16" CL 150 PVC Pipe	0	LF	$29.20	$0	$865,000
		18" CL 150 PVC Pipe	0	LF	$36.08	$0	$865,000
		20" CL 150 PVC Pipe	1000	LF	$45.05	$45,000	$910,000
		24" CL 150 PVC Pipe	1900	LF	$63.01	$120,000	$985,000
		6" Gate Valve w/box & P.I.	4	EA	$1,085.62	$4,000	$989,000
		8" Gate Valve w/box & P.I.	0	EA	$1,383.90	$0	$989,000
		12" Gate Valve w/box & P.I.	0	EA	$2,130.13	$0	$989,000
		BF Preventer Ass'y, 6"	4	EA	$4,417.31	$18,000	$1,007,000
		BF Preventer Ass'y, 8"	0	EA	$7,512.91	$0	$1,007,000
		BF Preventer Ass'y, 12"	0	EA	$14,589.47	$0	$1,007,000
		Precast BF Preventer Vault	4	EA	$8,000.00	$32,000	$1,039,000
		Pipe Installation on Bridge	100	LF	$200.00	$20,000	$1,059,000
		CONSTRUCTION COST				$1,104,000	$1,104,000
		Estimating Contingency	30	%		$331,000	$1,435,000
		TOTAL CONSTRUCTION COST				$1,435,000	**$1,435,000**
		Engineering, Legal, and Administrative Contingency	20	%		$287,000	$1,722,000
					TOTAL PROJECT COST =		**$1,722,000**

Notes: Extra cost associated with buried pipe across Willows GC not included
Pipe along south side of Soccer fields (1A1.1) buried under gravel parking lot rather than 116th St.
Pipe is assumed to be hung from associated bridges at all river crossings

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DETAILED COST ESTIMATE

PROJECT : Sammamish Valley RWPF

JOB # : 6700A.10 **DATE :** 9/10/2002

LOCATION : Seattle, WA Area **BY :** GLS/DVK

ELEMENT : West 60-Acres South - Scenario 2B **REVIEWED BY:**

SPEC	ID	DESCRIPTION	QUAN	UNIT	UNIT COST	SUBTOTAL	TOTAL
2		**SITEWORK**					
		Clearing & Grubbing, Grass & Sod	25880	SY	$0.22	$6,000	$6,000
		Trench Exc, Tracked Hoe, Open Areas	29111	CY	$1.58	$46,000	$52,000
		Trench Exc, Tracked Hoe, Traffic Areas	1260	CY	$2.17	$3,000	$55,000
		Trench Protection	35800	LF	$6.75	$241,000	$296,000
		Dewatering (Pump & Haul to Sewer)	35800	LF	$5.85	$209,000	$505,000
		CDF Pipe Zone (Open Areas)	9610	CY	$56.00	$538,000	$1,043,000
		CDF Pipe Zone (Traffic Areas)	403	CY	$60.00	$24,000	$1,067,000
		Imported Trench Backfill	18503	CY	$21.61	$400,000	$1,467,000
		Haul & Dispose Trench Spoils (1.2 Bulking Factor)	36445	CY	$12.75	$465,000	$1,932,000
		Cut AC Pavement, 4" Thick	1620	LF	$2.64	$4,000	$1,936,000
		Remove AC Pavement	2160	SY	$4.85	$10,000	$1,946,000
		Crushed Surfacing Base Course, 6"	180	CY	$24.45	$4,000	$1,950,000
		Crushed Surfacing Top Course, 2"	60	CY	$28.67	$2,000	$1,952,000
		AC Paving, Class B, 4" Thick	720	SY	$8.75	$6,000	$1,958,000
		Hydroseeding	213480	SF	$0.11	$23,000	$1,981,000
		Purple Metallic Location Tape	35800	LF	$1.05	$38,000	$2,019,000
		Traffic Control, Allow	1620	LF	$10.00	$16,000	$2,035,000
		Culvert Protection	2	EA	$10,000	$20,000	$2,055,000
		Bored and Jacked Undercrossing	100	LF	$850.65	$85,000	$2,140,000
13		**SPECIAL CONSTRUCTION**					
		Flow Meter	5	EA	$14,000.00	$70,000	$2,210,000
15		**MECHANICAL**					
		6" CL 150 PVC Pipe	4000	LF	$6.43	$26,000	$2,236,000
		8" CL 150 PVC Pipe	0	LF	$9.41	$0	$2,236,000
		12" CL 150 PVC Pipe	5000	LF	$18.76	$94,000	$2,330,000
		14" CL 150 PVC Pipe	5000	LF	$23.98	$120,000	$2,450,000
		16" CL 150 PVC Pipe	20000	LF	$29.20	$584,000	$2,914,000
		18" CL 150 PVC Pipe	1800	LF	$36.08	$65,000	$2,979,000
		24" CL 150 PVC Pipe	0	LF	$63.01	$0	$2,979,000
		6" Gate Valve w/box & P.I.	2	EA	$1,085.62	$2,000	$2,981,000
		8" Gate Valve w/box & P.I.	0	EA	$1,383.90	$0	$2,981,000
		12" Gate Valve w/box & P.I.	3	EA	$2,130.13	$6,000	$2,987,000
		BF Preventer Ass'y, 6"	2	EA	$4,417.31	$9,000	$2,996,000
		BF Preventer Ass'y, 8"	0	EA	$7,512.91	$0	$2,996,000
		BF Preventer Ass'y, 12"	3	EA	$14,589.47	$44,000	$3,040,000
		Precast BF Preventer Vault	5	EA	$8,000.00	$40,000	$3,080,000
		Pipe Installation on Bridge	200	LF	$200.00	$40,000	$3,120,000
		CONSTRUCTION COST				$3,240,000	$3,240,000
		Estimating Contingency	30	%		$972,000	$4,212,000
		TOTAL CONSTRUCTION COST				$4,212,000	**$4,212,000**
		Engineering, Legal, and Administrative Contingency	20	%		$842,000	$5,054,000
					TOTAL PROJECT COST =		**$5,054,000**

Notes: Pipe is assumed to be hung from associated bridges at all river crossings
A 12" Gate Valve w/box & P.I. was included for the 16" pipe leading to Marymoor (2B.2)

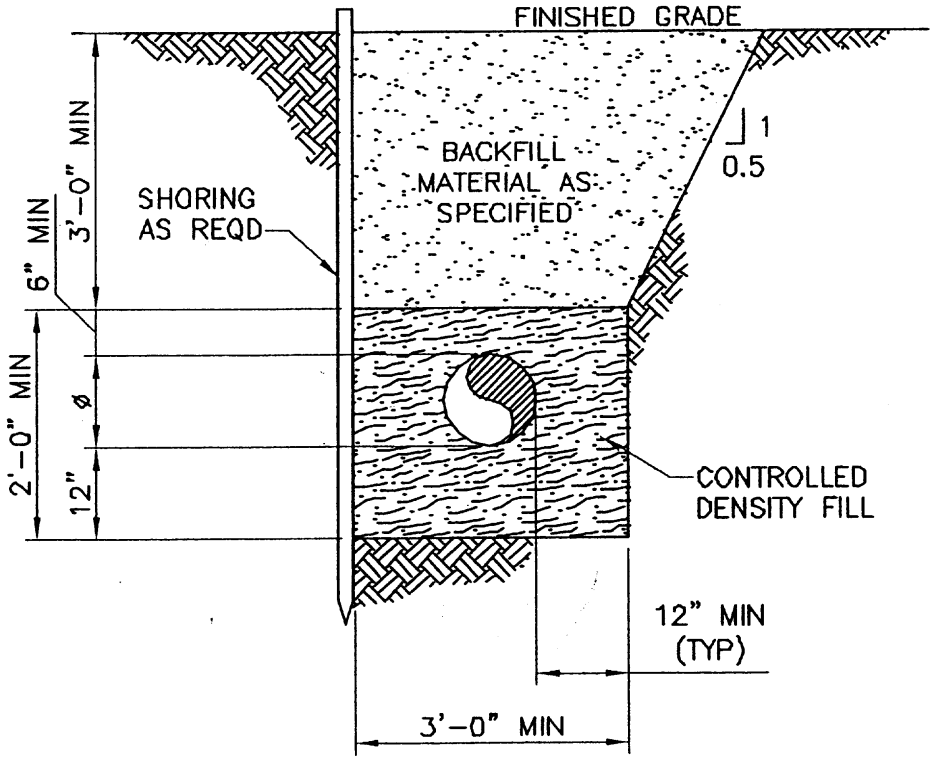

FIGURE 11.1

SAMMAMISH VALLEY RECLAIMED WATER PRODUCTION FACILITY
KING COUNTY DEPARTMENT OF NATURAL RESOURCES & PARKS
PIPE TRENCH CROSS SECTION IN OPEN COUNTRY

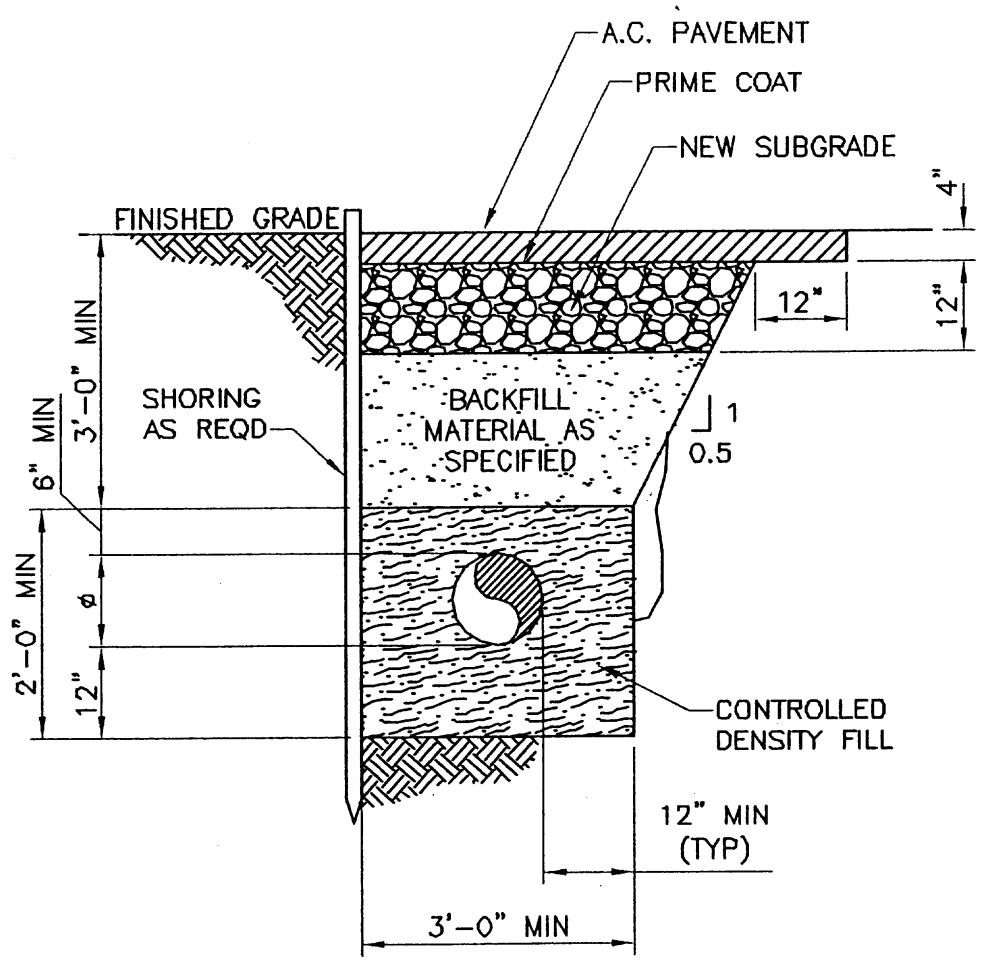

FIGURE 11.2

SAMMAMISH VALLEY RECLAIMED WATER PRODUCTION FACILITY
KING COUNTY DEPARTMENT OF NATURAL RESOURCES & PARKS
PIPE TRENCH CROSS SECTION IN PAVED ROADWAY